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[OFFICIAL NOTICE.]

Fourth Annual Meeting, Southwestern Gas, Electric and Street Railway Association.

SOUTHWESTERN GAS, ELECTRIC AND STREET RAILWAY ASSOCIATION,
OFFICE OF THE SECRETARY,
WACO, TEX., Feb. 8th, 1902.

The Fourth Annual Meeting of the Southwestern Gas, Electric and Street Railway Association will be held in San Antonio, Tex., on the 18th to the 21st of April, 1902. As the membership is alive with interest, both on account of the place selected to meet and the good results to be obtained, a successful meeting is therefore assured. The headquarters and programme in detail will be announced later.

T. H. STUART, Sec'y.

[OFFICIAL NOTICE.]

Wrinkle Department, Western Gas Association.

WESTERN GAS ASSOCIATION,
OFFICE OF WRINKLE DEPARTMENT.
BELLEVILLE, ILLS., February 12th, 1902.

This department is now open and ready for contributions, which will be presented at the Twenty-fifth Annual Meeting to be held next May. The active co-operation of all members and friends is earnestly solicited. Please forward contributions to the Editor before April 15th.

W. E. STEINWEDELL, Editor.

BRIEFLY TOLD.

AN EXCELLENT PRESIDENTIAL ADDRESS.—The JOURNAL for this week contains the text of the address, delivered by Mr. Henry L. Doherty, President of the Ohio Gas Light Association, before that body on the occasion of its 18th annual meeting. Our dispatches of a week ago amply attested that the convention was a success in every respect, viewed from a technical standpoint, even though a marked innovation—that of failing to have what are known as "set" or prepared papers contributed, the substitutes thereto being written opinions on named topics handed in by members asked to prepare such "briefs" in advance as provokers of discussions—was inaugurated. The plan, whether from its novelty or other cause, exceeded we are quite sure in its working the best hopes of those who promoted it, and it is likely that some of the other Associations will have a try at the system, the strength of which, however, in our belief can only be told by the experience born of time. The matter, though, of this comment, lies in the President's address, the virility of which would seem an argument against short "written opinions;" for in its length there is nothing that is not interesting. Differ as one may or will from any of the points put out by Mr. Doherty, all must admit that even the "differing points" are of interest and provocative of fair discussion. Examining the address from varying standards and standpoints, whether one agrees or disagrees with thoughts advanced, the final conclusion reached must be that no other contribution to the technical proceedings of the Ohio's 18th meeting exceeded or equaled in interest, the address of its President.

LIBRARY OF CONGRESS
APR 2 1902
SMITHSONIAN DEPOSIT.

OBITUARY NOTE: MAJOR R. R. SWEPSON.—Maj. Robert Redd Swepson, President of the Knoxville (Tenn.) Gas Light Company, died at his home in West Knoxville, the morning of Sunday, the 23d inst., after an illness of several months. Deceased was not very well known to the industry at large, in that he seldom mingled with his fellow gas men, but his faith in gas trading was of the most positive sort. And it might well have been so, for his satisfactory commercial returns, from his long control of the Knoxville Company were of the sort that cannot be denied by any unbeliever. Deceased was born in Mecklenburg, Va., October 13, 1825, and received the finishing touches to his education in Wake Forest College, Wake county, N. C., from which institution he graduated in 1848. His father (Wm. Mallory Swepson) was quite a capitalist in his day and time, and the father's keen commercial instincts found good development in the son's practice. His first business venture on personal account was in connection with the street railways of Richmond, Va., in which city he resided during the war of the rebellion. To show how facile he was, we may only remark that during the trying times between 1861 and 1864, as a resident of Richmond, he was always regarded as "neutral." In 1865 he came to New York and established the general commission house of Swepson, Mendenhall & Company, with headquarters in 79 Pearl street. This firm had much to do with raw cotton that had been handled at one time or another in different Southern ports during the stormy period of the war. In a year or so important business interests held by him in Knoxville, Tenn., impelled him to visit that city with the result that his future active commercial life was spent there. From 1867 to 1872 he acted as President of the First National Bank, and in 1876 he was elected President of the Knoxville Gas Light Company, the control of which he acquired through his affiliations with the First National Bank. As might naturally be inferred from the foregoing recital, he was vitally interested in many other important business enterprises than those named. He never married, and no nearer next of kin than nephews and nieces survive him. The funeral services were held the morning of the 25th inst., the Rev. Dr. Ringgold, rector of St. John's Episcopal Church, officiating, and interment was subsequently made in Gray Cemetery.

SEVENTEENTH ANNUAL REPORT, MASSACHUSETTS BOARD OF GAS AND ELECTRIC LIGHT COMMISSIONERS.—We are in receipt of this record of the proceedings of the Commissioners, through the attention of President Barker. As was the case with its predecessors, the volume abounds in information that is valuable to everyone concerned in the supply of artificial light and power from central stations; and it need not be said that its figures are authentic. The figures show that gas is "doing pretty well up Massachusetts way;" in fact, they show that the industry occupies and holds a stronger position than any heretofore held by it. Next week we will give some resume of the book and its tables.

NOTES.—The proprietors of the Ionia (Mich.) Gas Light and Coke Company have placed an order for a complete, new, up-to-date coal gas plant with the Lloyd Construction Company, of Detroit, Mich. The plant, which is to be placed in entirely new buildings, when completed will be a model one.——The corporate title of the Pekin (Ills.) Light, Heat and Power Company has been changed to that of the Citizens Gas and Electric Company, of Pekin. The original bond issue of $100,000 has been paid off, and a new issue of $150,000 has been arranged for. The plants will be reconstructed. Mr. Henry C. Herget succeeds his father (Mr. George Herget) as President, and Mr. William P. Herget has been re-elected Secretary and Treasurer.——The proprietors of the South Jersey Gas, Electric and Traction Company have notified the residents that, after the 1st prox., the uniform selling rate of $1 per 1,000 shall rule over the entire Camden district.——The United Gas Improvement Company, which has been operating the works of the Harrisburg (Pa.) Gas Company, under leasehold since 1882, has purchased the plant and good-will outright. This it had the right to do at a named figure in the lease, on the expiration of the latter, which terminated some time ago.——Mr. William E. Steinwedell has resigned the position of Superintendent of the Belleville (Ills.) Gas and Electric Company, to accept a responsible place in connection with an important Eastern Company. He will not leave Belleville, however, until the betterments now under way on that plant are completed.——Mr. John R. Triplett, at one time Secretary of the old St. Louis (Mo.) Gas Light Company, died at his home in that city the evening of March 21st. He was in his 72d year.——The stock of the Pacific Gas Improvement Company, of San Francisco, Cal., is to be increased by issue of 3,000 shares of the par value of $100 each.——The Board of Gas and Electric Light Commissioners have assented to an increase in the stock of the Dorchester (Mass.) Gas Light Company, amounting to 400 shares. The par value is $100, and the upset price named by the Commissioners is $125 per share.

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.—Concluded from Page 413.]

PROCEEDINGS, THIRTY-SECOND ANNUAL MEETING, NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

HELD AT THE PARKER HOUSE, BOSTON, FEB. 19 AND 20, 1902.

SECOND DAY, FEB. 20, MORNING SESSION.

Discussion on the Paper[1] on "Coal Gas Treatment," by Mr. A. B. Slater, Jr.

The President—Mr. Prichard, we would like to hear from you on this subject.

Mr. Prichard—Mr. President, I had much rather hear from some one else and come in later myself, but I suppose I have to do as you say. I am very much interested in Mr. Slater's paper, and I imagine I read it over at least a dozen times, because the first year of the last two I was engaged in planning a plant to accomplish something like what he has described, and for the last year have been operating this plant when completed. The stress that he lays on the various points is very fully borne out by my experience. We have this question of gas handling coming constantly before us. It reminds me of the old saying about advertising, that it was necessary for a man to advertise about a million times before the general public get it into their heads at all that the thing was being spoken of. And so it is with this gas handling apparatus. In 1867 Dr. Bowditch published a book on "Condensation," which was one of the best things that ever was written; and from that time down to the present we have been having articles just along this same line, and we have not yet got it knocked into our heads. I imagine that 50 per cent. of the plants running to-day are robbing their gas by means of tar that is cold, and tar that is lukewarm, and we don't seem to rise to the thing at all. It is a very great benefit to this Association to have this matter brought up by Mr. Slater and have it very fully discussed. Regarding the P. and A. condenser, I don't know whether I made a mistake in not putting one in or not, but as he read the paper, and as I looked it through, there was one point on which I would like to ask him a question, which is whether he made any tests of the aqueous vapor before and after the P. and A. condenser. The inference that I draw from the paper is that the P. and A. has diminished the quantity of aqueous vapor held by the crude gas. If Mr. Slater has made any tests on that I should be glad to hear from him.

Mr. A. B. Slater, Jr.—I have made some tests in regard thereto, and find that is, as would naturally be expected, a matter depending almost entirely on temperatures. If the gas is taken to the P. and A. very warm, the reduction in the amount of aqueous vapor is very small; but if it is cooler (say if is taken to the P. and A. at a temperature of 120° F.), the amount of aqueous vapor before and after passing the P. and A. would vary a little. But if the gas goes in at a temperature of 90°, the total amount of aqueous vapor will be less when it reaches there, but the reduction of aqueous vapor in the P. and A. will be proportionately more.

Mr. Prichard—I want to say, Mr. President, following my starting point, that during the past two years we have put up a gas-handling plant, as I call it, which seems to work very nicely. We take the gas, first, from the hydraulic mains to the exhauster, then from the exhauster to a three-section Walker tar extractor—in other words, three immersions. Gas enters that tar extractor at somewhat varying temperatures; we will say 115° to 120°. It passes from the tar extractor to the water condensers; from there to the standard scrubber; and from there to a set of 4 boxes, 7 feet deep by 24 feet square. We attempt to keep the temperature in the tar extractor from 115° to 90°. Then it goes into the condenser, where it is cooled down to about 65°, and then passes on to the standard scrubber where the ammonia is taken out. Then it is reheated and put into the boxes at a temperature of about 70°, in the first box, and allowed to cool down, as it passes through the various boxes, till it gets to about 65°, when it is measured in the station meter. Now, I suppose all of us, at one time or another, have had the opportunity to go through our works and see the vast amount of tar that we can find almost anywhere in the plant, from the exhauster to the purifiers. I suppose almost every man here, at some time or other, has taken down his purifying connections and found them half full of tar. If that tar was there, and it is there (I think you will all agree with me that you have found it there time and time again), and if the effects on tar are, as Mr. Slater states, and I thoroughly agree with him, it seems to me it will explain to all of us how much we have been robbing our

1. For the text of Mr. Slater's paper, see JOURNAL, March 24, p. 411.

stockholders and our dividends. In our own case, the change in the last year, and we have just finished one complete year, in producing the same number of candle feet this last year that we produced a year before, we made a saving in hard cold cash outlay of $5,600, and it is mostly due to keeping cold or lukewarm tar from contact with good gas.

Mr. Addicks—Mr. President, I would like to ask Mr. Slater if I have gotten a correct impression from the reading of his little classic that, while naphthaline is absorbed by the hot tar, the aqueous vapor and the benzole, he means to have us understand that that portion of the naphthaline which is held in solution (if I may use that expression) by the benzole is the portion that may safely be taken to the burner?

Mr. A. B. Slater, Jr.—The naphthaline which may be safely left to go to the consumer's burner is that proportion which can be carried by the benzole alone through the varying conditions of distribution. I think on that point, too, there is a very strange idea amongst a great many gas men that they must not cool their gas below 60°. They seem to have an idea somehow that 60° is some sort of standard that must be maintained as the proper temperature to which to bring the gas at the works, and that is all there is about it. But while 60° is a good temperature at which to measure the gas, and is also a good temperature at which to remove the ammonia, still at that temperature there will be held in suspension by the gas certain vapors. If the temperature is very much reduced, as is often the case in distributing systems—for instance, where the gas is subjected to (in some cities) 10° below zero perhaps—there certainly some of those vapors must be condensed at that low temperature which would not be condensed at 60°, and if they are condensed at that low temperature it seems to me it would be useless to send them into the distributing system and have them condensed there, where they have to be pumped out and carried back to the works, to be used for carburetting water gas, or, as is very often the case, thrown away. That is why I say the gas might well be cooled to as low a temperature as it would meet in the distributing system, because if you cool the gas to a certain temperature it makes little difference whether it is done in the works or in the distributing system, for you will cause the condensation of certain vapors, excepting that when cooled down to that point in the works before the final purification of the gas, the condensation of some of those vapors will be affected by the condensation of others, if their boiling points are near each other. It is a fact that if there are two vapors in the gas, one of which has a slightly lower boiling point than the other, if the gas is very quickly cooled, so that the one with the highest boiling point is condensed, it will in its condensation bring down more of the second vapor than would normally come down at the same temperature and pressure.

Mr. Addicks—May I just add a further question, so as not to lose the thread? I would like to ask Mr. Slater, if we assume for the moment the desirable quantity of benzole, I mean by that under a normally made coal gas of normal candle power, and then assume that the naphthaline in solution is, we will say, a saturate solution for that benzole under those conditions, the whole forming a desirable gas to put at the burner, how low does he think the temperature of that gas can go without depositing the naphthaline as a solid disassociated from the benzole; I mean in degrees F.

Mr. A. B. Slater, Jr.—If you assume a gas to have a normal amount of benzole, say about 1 per cent., and that benzole is carrying its *full complement* of naphthaline, that being at normal temperature, say about 60°, and at the usual pressure, perhaps a couple of inches, then just as the temperature is reduced the power of that benzole to carry naphthaline is reduced—that is, the cooler the benzole the less able it is to hold naphthaline in solution. So that if you cool the gas ever so little there will be proportionately some tendency for that benzole to drop a little naphthaline.

Mr. Addicks—But will it drop out of the gas even then entirely? Will it be deposited?

Mr. A. B. Slater, Jr.—That will depend on whether the other vapors in the gas are able to carry it. If there is anything else in the gas that can carry it when the benzole lets go of it, that distribution will take place in the gas without change of temperature. I can hardly suppose a case wherein the vapor of benzole in the gas would carry a full complement of naphthaline and the other vapors in the gas not carry theirs. That distribution I think would unquestionably take place, so that the various vapors would each have their relative proportion of naphthaline to carry. In order to suppose that the benzole carries its full complement, we must suppose that all the other vapors carry their proportionate complements. If the temperature is reduced the aqueous vapor will be the first to drop what naphthaline it carries and when that goes down there a small proportion will come from that carried by the benzole, and the amount of naphthaline dropped will increase as the temperature reduces, simply because the carrying power of the vapors decreases as the temperature goes down. At just what temperature the amount of naphthaline that is deposited would become troublesome would be pretty difficult to state, because it would be an increasing function as the temperature went down, and just where the point would be reached where no more naphthaline would be carried in suspension I think you would find rather below any temperature at which we are apt to distribute gas.

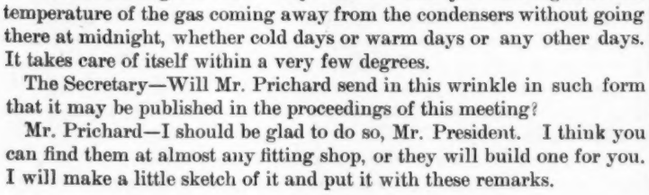
Mr. Wood—Mr. President, this paper appeals to me, as it did to Mr. Prichard, and as I think it must to all of you, from the stress which the author puts on a part of the apparatus which is too often neglected: the condensers. It would please me if I could ask Mr. Slater as many questions as were put to our friend from Fall River, but I find that his reasoning and conclusions so correspond to and fit into my own knowledge and belief on this subject, as justified by my own experience, that I can only pat him on the back and say "Amen." The question of condensers has always been more or less of a hobby with me, and I have quite a collection of notes which I had intended to incorporate in a paper to be read to the Association at some future time. Mr. Slater has rendered that unnecessary, and for that I thank him. His paper is so comprehensive that I find little to criticise. The apparatus in a gas works has happily been likened by some one, I have forgotten who, to the human organization, and you can all see, without my enumerating them, which parts correspond to the various parts of the human body. But it is self evident that the condensers constitute the bowels of the gas works. The careful manager, by frequent observation of thermometers, pressure gauges, drips, station meters and holders, can tell whether the conditions are normal and satisfactory. Am I right when I say that the thermometer is too often ignored and neglected? Whether I am right or wrong, you will agree that in the case of the medical practitioner such neglect would class him as careless, to say the least. One statement Mr. Slater makes is that among European gas works there appears to be a fair degree of uniformity in methods of treating crude coal gas. That may be true as to methods and apparatus, but lately I was comparing the description of two German works; probably most of you have seen it. These included a works of large size and one of fairly large size, and it was claimed of the smaller of the two that it was laid out after a careful mathematical and scientific computation for every part of the apparatus. Nothing was taken for granted, and it was supposed to represent the best modern European, or that part of European thought on the subject. After I read Mr. Slater's paper I compared the apparatus in those two works, and find that the arrangement, in line, of different parts is similar; and there is no disagreement as to methods, so far as that goes. But when it came to areas, there was a wide difference, especially with regard to the atmospheric condensers. In one works the square feet per 1,000 in 24 hours was 4.7, and in the other 7½, so that there is evidently some disagreement between our European friends, from the theoretic standpoint, in this matter. I think we must all agree with Mr. Slater that the proper arrangement of the apparatus is atmospheric cooling in large areas at slow velocity, followed by friction, or change of direction, or filtration, at a higher velocity, and that followed by water cooling, and such an adjustment of the water cooling that the difference between the entering gas and out-going water will be just enough to do the work and no more, and that that condition shall be maintained throughout the length of the water cooler. Now, that is an ideal condition. It may not always be obtainable, but it can be approximated, and the closer you come to it in my belief the better off you will be. I would like to add one suggestion to that thought, and it refers particularly to the New England climate. Suppose your air condensers were adjusted to take care of your make at midday in the last week in October, and you have a heavy make. The atmospheric temperature may be 80°. Now, if your condensers are adjusted so that your outlet temperature is satisfactory at noon, at midnight the thermometer may be down to 32°. If no change is made in the apparatus the conditions are decidedly wrong, and trouble will follow. That leads to the suggestion that that part of the apparatus preceding the multitubular should be in small units which can be put off or on as occasion demands. One other suggestion I would like to make is in reference to the washing with ammoniacal liquor, and that is that it may be found desirable to cool the liquor as well as maintain the gas at a certain temperature. It is possible that if you are drawing the liquor from a hot well it may be too hot to do good work, and provision should be made for passing it through some cooling apparatus. I have found the water in the holder tank useful for this purpose.

Mr. Prichard—Touching that point Mr. Wood made, I can suggest a wrinkle. We regulate our water going through the multitubular condensers by the outlet. On the outlet we have an expansion trap, which

is made up of a piece of iron pipe and a piece of brass pipe and a piece of a second-hand globe valve. By means of that you can regulate the temperature of the gas coming away from the condensers without going there at midnight, whether cold days or warm days or any other days. It takes care of itself within a very few degrees.

The Secretary—Will Mr. Prichard send in this wrinkle in such form that it may be published in the proceedings of this meeting?

Mr. Prichard—I should be glad to do so, Mr. President. I think you can find them at almost any fitting shop, or they will build one for you. I will make a little sketch of it and put it with these remarks.



Sketch Subsequently Submitted by Mr. Prichard.

Mr. A. B. Slater, Jr.—I would like to ask Mr. Wood whether in his remark about adjusting the condensers to the variation of temperature he meant to vary the conditions so as to maintain the same temperature for the gas after cooling, or to vary the temperature of the gas after cooling to suit the changed conditions of outside temperature?

Mr. Wood—That is what I had in mind. If the air condensers are proportioned to care for the maximum make of gas in winter, conditions of atmospheric temperature and make may arise at a different season which will render it difficult to maintain a suitable gas temperature at the inlet of the multitubular. In meeting such conditions I have found the subdivision of the air condenser a great advantage.

Mr. A. B. Slater, Jr.—That point is, in European practice, covered to some extent by simply putting the condensers out of doors, so that the gas is affected just in proportion as the outside temperature varies.

Mr. Prichard—Mr. President, I don't want to do all the talking, but the remark that Mr. Slater makes on page 7 regarding the P. and A. condenser and the Walker tar extractor, as representing the two types, is one that interests me very much, because I would like to know if we made a mistake in adopting the Walker instead of the P. and A. It seems to me as though Mr. Slater's opinion of it was based on the fact that the Walker tar extractor, or any immersion extractor, would add aqueous vapor to the apparatus. It was for that reason I asked him if he had made any test of the P. and A. condenser, as to whether that took out aqueous vapor, because I wanted to compare his results with some that I had made myself on aqueous vapor. I find the following to be the fact in our case, that the gas coming from the hydraulic main and passing into the inlet of the tar extractor was saturated with aqueous vapor three times out of four, and practically saturated the fourth time. In either case on the outlet of the tar extractor it was saturated. At the outlet of the condensers it was within 4 per cent. of saturation, at the outlet of the scrubbers it was saturated, at the outlet of the boxes it was about 85 per cent. saturation, and at the outlet of the governor, passing out on to the street, it was about 75 per cent. saturation. In another form, of the total aqueous vapor there was in the gas coming from the hydraulic mains, the tar extractor removed 31 per cent., the condensers took out 50 per cent., the standard scrubber added 3 per cent., and the boxes removed 1 per cent. Now, if the P. and A. condenser, by virtue of the condensing power of small apertures removes any aqueous vapor, it seems to me it has a decided advantage over the Walker tar extractor. The P. and A., as I understand it, has the disadvantage of the slots or apertures clogging up, and it seems to me it also has the disadvantage of keeping the gas in intimate contact with the tar, which, I believe, is a thing we don't desire to do. If, on the other hand, it has a compensating advantage of relieving us of aqueous vapor, then perhaps it is a thing that we ought to adopt rather than the other form. It is along those lines that I am anxious to have the matter discussed.

Mr. A. B. Slater, Jr.—Mr. President, referring to the question as between the P. and A. and the water immersion tar extractor of the Walker type, I would say that the P. and A. reduces the aqueous vapor very slightly, perhaps not over 5 per cent., and at the same time with the P. and A. there is very small practical chance of its being increased, whereas with the immersion type of apparatus it can be operated so as to keep your aqueous vapor up, and if your aqueous vapor is not at the point of saturation before it gets there it may be operated so as to make it come up to that point. The objection to the P. and A. has almost invariably been, as Mr. Prichard stated, its liability to clog up and for the tar to take out the illuminants, but from my experience I consider that result to be almost entirely a matter of temperature. There is one thing outside of temperature. If the P. and A. is put close enough to the hydraulic main, and you are distilling coal with light charges and distilling very hard at high heats, you carry over a lot of fixed carbon that goes by the hydraulic main, and your tar in the P. and A. would catch it, then you have a chance of sticking up even at high temperatures; but if the P. and A. is not put near enough to the hydraulic main to catch any of that coarse soot, as I call it, or fixed carbon, then it seems to me from my experience it is a matter of temperature almost altogether, because if the tar is kept hot enough it will flow away. With very hot tar we never have had any trouble at all with the holes sticking up in the P. and A. Of course the power of the tar to absorb the illuminants increases with the decrease of temperature, so that the hotter you can keep that tar the better. For that reason I believe in having the gas go to the P. and A. tar extractor at as high a temperature as may be after taking the gas from the hydraulic main, say put it in at 140°, if you can get it there, because at that temperature the absorption of illuminants would be very small. The tar on condensing there will bring down some naphthaline, but at that temperature it is not apt to bring down any appreciable amount of benzole. And one point there is to let that tar, on condensing at that point, bring down as much of the naphthaline as you can, so as to condense that naphthaline without doing it at the expense of the benzole.

Mr. McKay—Will Mr. Prichard tell us the highest temperature, degrees F., that he has ever found coal gas to be saturated with aqueous vapor? Has Mr. Slater made any experiments on this?

Mr. Prichard—I don't remember the temperatures very closely, but generally we get the gas going into the tar extractor at about 120°, and it is saturated at that point. That is the first place I have ever made any tests on the saturation; but I see no reason why it should not be saturated from the standpipes to this point. The dropping of water is very considerable between the inlet and outlet of the tar extractor, and a very large amount between the outlet of the tar extractor and the outlet of the condenser. I am going to thank Mr. McKay for those tables which he got up several years ago, which I used in this particular case, and they were very good indeed.

Mr. H. C. Slater—In speaking of these temperatures it may be interesting to note that the boiling point of benzole and the melting point of naphthaline are very close together. The boiling point of benzole, I believe, is given as 80.4° C., and the melting point of naphthaline at 79° C.

Mr. D. D. Barnum—In the light of Capt. McKay's paper, entitled "Temperature," and read before the New England Association in 1897, Mr. Slater's paper is very interesting. In looking over the paper I found one or two points which I would like to ask Mr. Slater about. On page 2 there is this statement: "The olefines are the most valuable." I had always thought that the value of a hydrocarbon constituent depended upon the ratio of the total carbon to the total hydrogen and the carbonic oxide in the mixture. For instance: A mixture with a high percentage of hydrogen would give better results if it had the acetylenes instead of the olefines; and one low in hydrogen, better results if it had paraffines instead of olefines. And if we consider the different groups of hydrocarbons as illuminants to be burned alone, it has been proved that the acetylenes give the highest candle power. In the same paragraph as the above is also found the following: "That the benzoles and other vapors are relied upon largely for the illuminating power." It is seldom that coal gas, after it is condensed, ever contains over 1.2 per cent. of condensible vapors. Mr. A. S. Miller, I believe, has found that they seldom or never exceed 2 per cent. in 30-candle power water gas. And it is hardly consistent with known determinations to figure on more than 3¼ candles per 1 per cent. of vapors in coal gas, and 1½ candles per 1 per cent. in water gas; consequently, at the best, we cannot count on more than 4 candles as due to the vapors in coal gas. It has been determined in England that washing the vapors out of the gas with heavy oils does not reduce the candle power over 2 candles. On page 5 the statement is found that the vapor tension of the benzole is reduced by contact with the tar films, tar surfaces, etc.; should this not say that the *amount* of vapor is reduced instead of the vapor tension? I would also like to ask at what temperature Mr. Slater thinks the gas should leave the water-cooled condenser, as compared with the average temperature of the atmosphere at any particular time of the year. In trying to determine this much-mooted question I have run across one or two facts which I will try to explain. Two questions confront us at the outset. What is the practical, critical temperature of the naphthaline, and what is the necessary resultant vapor tension of the absorbent vapors, that will take care of the naphthaline at the critical time? Mr. Slater explains how this second condition was fulfilled at the South works of Providence; but these conditions are very hard to obtain, and probably

few of us ever do or ever will obtain them. For the past few years the Worcester (Mass.) Company has kept a series of charts showing the average temperature each day compared with the number of naphthaline complaints. It is found on examining these charts that in the fall, when the temperature hovers around 50°, the trouble comes, and for a week or 10 days, while the temperature remains about 50°, naphthaline is the most prevalent; and it is possible each fall, by keeping track of the temperature, to tell within a few days when the trouble will commence and when it will end. To further check this point, and find the average temperature of the gas in the pipes at this time of the year, I calculated from the amount of drip liquor pumped from the pipes outside the holder, the fall of temperature of the gas after it left the holder, and from the known temperature of the gas, as it left the holder, in a saturated condition, I found the approximate average temperature of the gas, as it left the mains, to be 49°. This temperature would actually be found about midway between summer and winter, and at about the time we get the naphthaline. I was able to check this figure by some data once taken in Boston, where the average temperature of the earth at a depth of 3 feet was found to be 48°. This all leads us to reason that the practical, critical temperature of the naphthaline carried by the gas in the mains is about 50°. The question now comes: How is the temperature of the gas at the outlet of the condensers to be regulated so that, when the gas comes to this critical point, as it necessarily must in this climate, the naphthaline will not drop out in crystals. In regulating the condensers we must remember that the gas must pass over the holder water and become saturated at a given temperature determined by that of the atmosphere. Mr. Slater states, as I understand him, that if we have a minimum amount of water vapor and a proper resultant vapor tension, that the naphthaline will take care of itself. But to do this, the naphthaline and the vapors must stand and fall together, which, as we all know, is a very difficult thing to make them do. It leaves the question, as I take it, somewhat in this way: Shall we cool the gas at the condensers, below the critical point, and thus have all our trouble at one point, or shall we condense to a safe margin above the critical point, and be free from trouble from mid-spring to mid-fall, have some trouble in the distributing system in the fall and spring, and then take care of it at the holder during the winter? The unpleasant part of the first scheme is taking care of it in the condensing apparatus. In the second plan, we might have trouble for a little while in the fall and spring, when the gas reaches the critical temperature in the distributing system, and possibly during the winter have some trouble with the inlet and outlet of the holder when the gas reaches the critical temperature at the holder; but this trouble at the holder can be greatly if not entirely obviated by having a large holder with large inlet and outlet pipes; or the trouble both at the holder and in the distributing system can be greatly reduced by either washing the gas with a heavy oil in a washer scrubber, and thereby remove the naphthaline, or by introducing some hydrocarbon vapor which will absorb the naphthaline at the proper time and place, or by using both these schemes.

Mr. J. J. Humphreys, Jr.—I should like to know if there is in use a centrifugal extractor removing tars and hot vapors from crude hot gas, but if there is not, undoubtedly the cream separator people could make a separator that would throw out any vapors, commencing at the heavy end and carrying it up to any point that we wish. Of course, it would entirely depend on the peripheral speed of the separator. I don't think with Mr. Slater, that you can let naphthaline leave the works at all and *never* have any trouble from it. If it is not economical to make a gas without naphthaline, then when the ground reaches the proper temperature you can either remove it (and some of the other vapors) at the works by extreme condensation and friction, or else let it leave your works with the certainty that it will deposit wherever it has to endure low temperature and friction for a sufficient time.

Mr. A. B. Slater, Jr.—There is no question as to the high candle power of acetylene, but the amount of it in coal gas is relatively quite small, and it is quite soluble in water. The real value of an illuminant must be determined on a commercial basis, and it is to be noted that for coal gas enrichment benzol vapor is quite largely and successfully used, especially in Europe, while acetylene succeeds best when by itself. With practically the same volume and temperature the less the tension, of course the less the actual amount of the vapor. To determine the proper temperature of the gas on leaving the last condenser, examine the composition of the gas and conditions of distribution. As regards a critical temperature for the deposition of naphthaline, that was something I was very much unable to determine. I found that, instead of being able to establish any really fixed temperature or approximate temperature at which the bulk of the naphthaline should appear, it would vary with the conditions of distillation and condensation so that you could bring it down almost anywhere in the works. You could bring it down easier than you could stop it, of course. But it depends so largely on the conditions of distillation that perhaps that should be made an important point here, fully as important as the condensation; for instance, if we use very fine coal, moist, and consequently have to charge a little lighter than we would with a nice quality of coal, unless we are very careful we are apt to make a great deal more naphthaline under such conditions than we would if we had nice coal, so that we should charge our retort pretty well up and get the gas out of the way quickly and not crack up our lower hydrocarbons so as to get a mess of naphthaline and marsh gas there. The naphthaline standing or falling with the vapors, I would make to be a result rather than an initial condition. The whole moral of the thing is—*make as little naphthaline as possible, and send no more into your distribution than your vapors can handle.*

Mr. J. J. Humphreys, Jr.—The amount of condensible vapors in the gas is 1.2 per cent. as usually given. Butterfield, I think, gives it so.

Mr. A. B. Slater, Jr.—Regarding the centrifugal tar extractor, I tried that myself as a matter of experiment, and know of three or four other instances in which it was tried, but it naturally would not be a commercial success. My trial of it was to note whether it would be possible to make a commercial success of it, and particularly to determine what the effect on the candle power would be. I found it affected the candle power very considerably, because as the tar was thrown to the outside and run around in the shield (I had simply a small blower), the heaviest vapors are also thrown out just in proportion to their specific gravity, so that if you undertake to do that thing at ordinary temperature, why your heaviest vapors are jammed hard up by centrifugal force against your tar there, where the tar can get right to work and absorb them as fast as temperature will allow. So the thing would have to be run very hot anyway, and I don't think it would ever be commercially successful, on account of the stratification of the vapors there, putting your heaviest vapors against the tar. If I skipped some points that were brought up, and if you will ask me the questions again, I will try to cover them.

Mr. McKay—As aqueous vapor and naphthaline are intimately associated in both coal and water gas, will Mr. Slater tell us if he has ever made any test of coal gas to determine whether the vapor it contained was that corresponding to saturation for a given temperature, and, if so, what is the highest temperature at which he has found coal gas to be saturated with aqueous vapor?

Mr. A. B. Slater, Jr.—The amount of aqueous vapor is almost always in my experience found to be slightly below saturation. That is, the precipitation of aqueous vapor I have found to exceed that required to maintain the vapor of saturation during decrease of temperature. I have not carried any experiments above 140° F., and up to that point there is quite an amount of aqueous vapor, well up towards saturation.

Mr. McKay—What percentage, Mr. Slater? Ninety per cent. of saturation?

Mr. A. B. Slater, Jr.—I should say quite 90 per cent.

Mr. McKay—If it would carry 90 per cent. at 140°, it would very quickly become saturated as the temperature fell?

Mr. A. B. Slater, Jr.—Yes.

Mr. McKay—That is, a few degrees lower would make it saturated?

Mr. A. B. Slater, Jr.—Yes; when the temperature has gone down to a point at which the amount of aqueous vapor in the gas has been concentrated to saturation, the further reduction of temperature will condense a proportionate amount of aqueous vapor, that which remains in the gas at any such lower temperature being theoretically at saturation for that temperature, provided conditions are such that temperature *only* is considered as affecting the vapor.

Mr. Africa—Mr. President, I should like to ask Mr. Slater if he has made any experiments relative to the effect of pressure on naphthaline. Suppose the gas at 2 inches pressure will carry a certain amount of naphthaline, what proportion of it will it carry at 8 inches? Mr. Addicks raised the question that if the gas was saturated with naphthaline, that is carrying all it will, if the temperature is reduced will the naphthaline be thrown down? Now, if the gas in the storage holder is, say, 8 inches pressure, it will carry a certain amount of naphthaline. We send it out to the mains, and the pressure reduces to, say, 2 inches. Will that reduction in pressure help the gas carry the naphthaline, and will it be enough to offset the reduction in temperature? I note that the plants which are distributing gas under what is known as high pressure report no deposits of naphthaline, in the services or mains. They evidently have enough reduction in pressure to offset any reduction of temperature they may have. The point is how much reduction in pressure must we have to offset a certain number of degrees loss in temperature?

Mr. A. B. Slater, Jr.—I think I get the idea. I have not made experiments on that point sufficiently to give a really good answer; but I should naturally expect that the reduction in pressure would favor the retention of the naphthaline in suspension, or you might call it gaseous solution, if I may use the term; I should expect the naphthaline to be better carried as the pressure was reduced and the temperature maintained within reasonable limits, or if the relation of temperature and pressure were maintained so that the charged vapor tensions and boiling points retained their position *relative* to each other, the status of the naphthaline solution would not be changed. I should not care to say that I thought it would be so through very wide limits though.

Mr. KcKay—With respect to this matter of pressure, and as having a bearing on Mr. Africa's remark does not Mr. Slater think it remarkable that, recalling the paper we heard yesterday, where the pressure is raised to 30 pounds, and the gas is chilled below zero, there is no occurrence of naphthaline mentioned in the writer's paper?

Mr. A. B. Slater, Jr.—It seems to me that it would not be anything very strange to see naphthaline deposited if much aqueous vapor were condensed, or even if much of the heavy hydrocarbon were condensed but in the latter case the naphthaline would probably be in solution in the resulting liquids. Evidently the gas that has been compressed in that way was well made and well condensed gas. I should doubt very much that it contained much naphthaline.

The Secretary—According to my recollection the statement was made in the paper, that in the district supplied by high pressure, there was no trouble from naphthaline deposits, but in the district supplied with the same gas, under ordinary pressure, there were numerous cases of trouble from naphthaline or frost.

Mr. A. B. Slater, Jr.—I think the idea might have been brought up at that time as to what happened during the compression of that gas, what was the effect of the condensation there. If the same gas distributed under low pressure will give a deposit of naphthaline and will not at a higher pressure, what becomes of the naphthaline? How have they taken care of it, if not dropping it at the time of compression?

The President—I want to ask Mr. McKay whether he thinks that watery vapor has very much to do with the deposit of naphthaline. Our friend here on my left seems to think so. I take it from our friend Prichard that he does not believe in it. Now, I want to hear from you; and, before you answer that, if I remember correctly, some 12 or 15 years ago, it was Mr. Lucien Brémond who made very elaborate researches in regard to the question of naphthaline, and he thought it was due wholly to watery vapor, and was a great believer in drying the gas. That created a great deal of discussion in England, and for a long time there were many publications on the question of naphthaline. If I remember correctly, Mr. William Young and Dr. Eitner, by a great many tests, took the ground that aqueous vapor had nothing whatever to do with the deposition of naphthaline. I think that point should be brought out here a little more fully. I doubt if it has much to do with it. Nobody has made any mention in regard to taking out naphthaline by using oil in the standard scrubber. Now, that can be done and done effectually. You will say, "Well, it will take out your candle power." It will, if you allow the oil to keep dropping into the scrubber; but if, in the first place, you should put in a certain amount of naphtha, you would find there would be no loss in candle power whatever. However, you must be careful to see that there is no tar in that scrubber, for if there is, you will get into serious trouble. A very thick emulsion will be formed.

Mr. Addicks—I want to move a vote of thanks to the writer of the paper, and also incidentally to congratulate the Association that we now know all about naphthaline and how to take it out of our gas! (Laughter.) The motion was adopted.

Mr. A. B. Slater, Jr.—The formation of naphthaline, and subsequently anthracene from benzole, is done by increasing the heat; that is, you distil your benzole from the coal in the retort, and if you allow it to remain in contact with the hot coke or with the surface of the retort it will, by absorption of heat, crush together two benzole hexagons, the benzole rings as they are called, and you will get naphthaline and ethylene; and by continuing that process, that is unite three benzole rings, you form anthracene and more ethylene, and then you form pyrene and chrysene in a similar way. A large part of the ethylene liberated in this way is probably broken up by the heat into marsh gas (methane), with the deposition of the surplus carbon in the retort. I have actually found cases where I thought I had a small quantity of naphthaline, but on examination I found, instead of having all naphthaline, I had a little naphthaline with quite a lot of anthracene, chrysene and pyrene, although it looked like naphthaline, the cause being always found to be unusually high heats and slow motion of the gas. Reference has been made to the paper by M. Brémond, and if any of the members care to look that up, they will get track of it in the *Gas World*, of 1888, Vol. 8, p. 11; and in the *Journal of Gas Lighting*, the same year, Vol. 30, p. 491. They will also find a reference to it in *Newbigging's Handbook*.

The President—The Secretary suggests that I had better present this question:

> "Which system of tar scrubbing is more approved: (a), By means of perforated plates or baffles as in apparatus of the P. and A. type; or (b), by means of a succession of water seals, as in apparatus of which the Walker tar extractor is a type?"

That question has been touched upon somewhat; but do you want to elucidate that, Mr. Prichard?

Mr. Prichard—I won't elucidate, but I will make one remark as showing the advantage of the Walker tar extractor. The average reduction of the sulphuretted hydrogen for the year, due to the tar extractor, was 28 per cent.; that due to the condenser was 9 per cent.; that due to the first box was 55 per cent.; that due to the second box 5 per cent.; that due to the third box nine-tenths of 1 per cent.; and that due to the fourth box three-tenths of 1 per cent.

The Secretary—I would like to ask Mr. Prichard if the other apparatus would not have taken this sulphide out if the Walker had not.

Mr. Prichard—Answering that question, I have not that record here, but the ammonia in the standard scrubber is cool and the temperature is relatively low, and we find on experiment that there is only a very small amount of sulphuretted hydrogen taken out by the standard scrubber, notwithstanding there is a large amount passing in the gas, for it has not yet reached the boxes yet. You have lots of it to operate upon, nevertheless the standard scrubber removes a very small amount of sulphuretted hydrogen; my remembrance of it is in the vicinity of 50 grains.

Mr. A. B. Slater, Jr.—Referring to the sulphuretted hydrogen taken out by the ammonia, I think in order to get satisfactory reaction there it is necessary to have the temperature fairly low and an excess of ammonia, and, of course, as the ammonia is absorbed in the scrubber there is not such a proportion of the ammonia gas free, as there would be in the case of a washer using the strong ammoniacal liquor. But in using a washer with strong ammoniacal liquor there may be quite a difference to some concerns because in doing that you get such a large proportion of your ammonia as salts and less free ammonia, and sometimes that makss a difference in the contract for selling your residual.

The President introduced Mr. C. A. Learned, of Meriden, Conn., who read a paper on

BUILDING A HOLDER FOUNDATION ON QUICKSAND.[1]

[For the text of Mr. Learned's paper, see JOURNAL, February 24, p. 262.]

Discussion.

The President—The paper is before you for discussion. Any questions to be asked?

Mr. Nettleton—We are under obligations to Mr. Learned for his paper, and he is to be congratulated on having built a large holder on very difficult foundations. Speaking for myself, with the description that he has given of the soil I should have hesitated, and I doubt if I should have had the courage to put up a holder on the foundations that he represents. I want to extend my hearty congratulations to him on the success of his work.

Mr. Allyn—I think Mr. Learned did not mention whether the cement was foreign or domestic.

Mr. Learned—It was Portland.

The President—What were the proportions?

Mr. Learned—One of cement, 2½ of fine, sharp sand, and 5 of broken stone. The stone was very clean.

On motion of Mr. Prichard a vote of thanks was tendered to Mr. Learned for his paper.

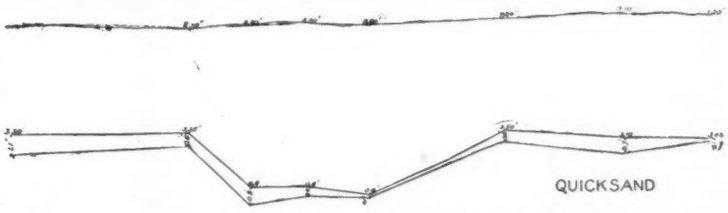
The President—We will now have the last question in the box.

> "What are the advantages in passing the water gas through separate purifying apparatus in a works making both coal and water gas?"

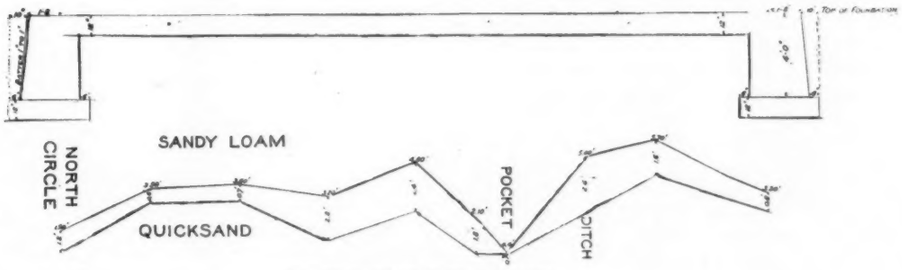
I think the only gentleman who can answer that is Mr. Prichard, which he will do now.

Mr. Prichard—I never had any experience in line with passing it through separate purifiers only. All my work has been in connection with the other apparatus also. Personally I do not think it makes any difference whether you purify them together or separately.

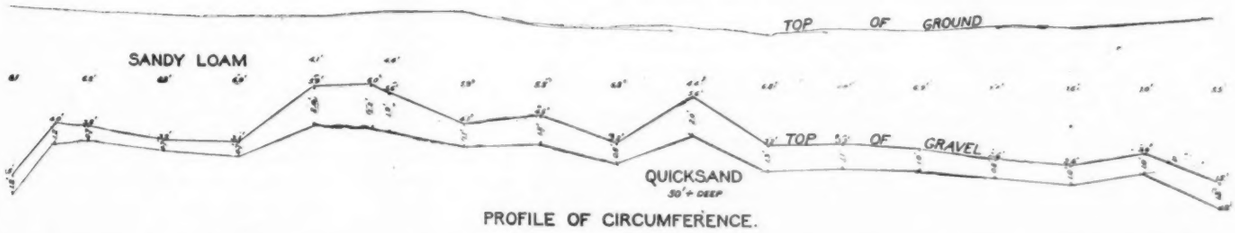
1. The illustration given on following page was subsequently submitted by Mr. Learned.



PROFILE OFF CENTRE OF TANK WEST TO EAST SHOWING THICKNESS OF GRAVEL.



PROFILE OF CENTRE OF TANK.



PROFILE OF CIRCUMFERENCE.

The President—Any further remarks in regard to the question?

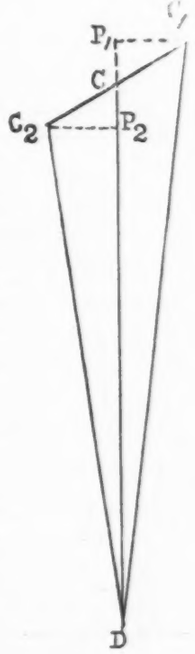
The Secretary—I would like to have brought out in connection with this the installation of shaving scrubbers for scrubbing water gas, which, I understand, is being done somewhat. We recently had some trouble with condensation passing on to the street and into consumers' meters, and it has shown at the burners. It looked to me very much like the condensation or the accumulation on the burners burning crude water gas in the laboratory, and I have been led to the conclusion that a part of this trouble might have been due to the fact that our water gas in the mixture was not properly scrubbed, as our condensing apparatus is overloaded.

The President introduced Mr. Charles W. Hinman, who read the following

NOTES ON CANDLE POWER DETERMINATIONS.

In all English speaking countries the standard for light is the English spermaceti candle when burning at the rate of 120 grains per hour. This standard is not an ideal one by any means, as numerous precautions have to be observed to obtain accurate results, and sometimes when all the known precautions have been observed the amount of light given off by the burning candle or candles seems abnormal. The greater part of the variation in the burning of candles is due to the wick. A photometric observer after having used candles for some time is able to tell whether or not a candle is burning properly; and if he is at liberty to reject an occasional imperfect candle his results are more worthy of confidence than though he uses every candle that consumes the legal amount of material. The appearance of a candle flame when burning properly and when not so burning has been described many times, and I will not repeat the descriptions here. The necessity of proper ventilation of the photometer room is often overlooked. A small photometer room is hard to ventilate properly on account of the liability of drafts. If there are no openings in the room, and all the ventilation must be through the walls of the room, then the cubic capacity of the room should be at least 2,000 feet. Some of the older experimenters used photometers that necessitated moving the candles during the experiment. Although this procedure allowed a constant illumination of the comparison disk, and was so far advantageous, yet it was fatal to the normal burning of the candles and has been abandoned. The early practice was to use a single candle, and to place the lights under comparison 100 inches apart. This arrangement left the determination subject to the peculiarities of one candle, and also gave a comparatively feeble illumination to the disk, thus rendering careful screening necessary. Later practice has been in the direction of shorter bars, 60-inch and 80-inch, and 2 candles are generally used. This arrangement gives a better illuminated disk, and the light for comparison is the average of that given by 2 candles. While this arrangement answers fairly well for ordinary candle powers, it is not well adapted to testing lights of 50-candle power, and cannot be used for lights of several hundred candle power. For testing these higher candle power lights it is a common practice to employ a secondary standard of 10 or more candle power, which has to be first standardized by means of candles and then used as a standard. This is a rather cumbersome process, and is not always convenient.

Having had occasion to make some high candle power tests it occurred to me to use quite a number of candles instead of two. Seven candles placed at the angles of a hexagon, and one in the center seemed the most available arrangement. To prevent the candles from being melted from the heat of adjacent candles, they were placed 2¼ inches from center to center. This distance was found to be sufficient for the purpose. This makes the distance between the extreme candles 4½ inches. The hexagon was not quite regular, but was distorted enough so that no candle was screened by another, and the appearance of the candles when viewed from the position of the disk was a row of flames ¾ inch from center to center. The question will immediately arise if a considerable error is not introduced by arranging the most of the candles so far from the center. If a bar 100 inches in length is used, and lights of from 16 to 110-candle power are to be tested, the error in question is quite insignificant.



In the Figure, let 3 candles, C_1, C and C_2, be in a straight line, C being midway between C_1 and C_2, D being the position of the disk. The illumination on the disk from the candles C_1, C and C_2 is inversely proportional to the square of C D, C_1 D and C_2 D. Drop perpendiculars from C_1 and C_2 on the line C D, and cutting it in P_1 and P_2, then:

$\overline{C_1D^2} = \overline{CD + CP_1}^2 + \overline{P_1C_1}^2 = \overline{CD}^2 + 2CD + \overline{CP_1}^2 + \overline{CP_1}^2 + \overline{C_1P_1}^2$ and $\overline{C_2D^2} = \overline{CD - CP_2}^2 + \overline{C_2P_2}^2 = \overline{CD}^2 - 2CD \times CP_2 + \overline{CP_2}^2 + \overline{C_2P_2}^2$.

Adding these two equations, and remembering that $CP_1 = CP_2$ and $C_1P_1 = C_2P_2$, we have:

$\overline{C_1D^2} + \overline{C_2D^2} = 2\overline{CD}^2 + \overline{CP_1}^2 + \overline{C_1P_1}^2 + \overline{CP_2}^2 + \overline{C_2P_2}^2$;

but $\overline{CP_1}^2 + \overline{C_1P_1}^2 = \overline{CC_1}^2$,

and $\overline{CP_2}^2 + \overline{C_2P_2}^2 = \overline{CC_2}^2$,

hence $\overline{C_1D^2} + \overline{C_2D^2} = 2\overline{CD}^2 + \overline{CC_1}^2 + \overline{CC_2}^2$.

That is, the sum of the squares of the distances of the 3 candles from the disk is equal to 3 times the square of the distance from the center candle to the disk, plus the sum of the squares of the distances of the 2 outer candles from the center one.

In the arrangement I have adopted there are: One candle at the center, 4 candles each 2¼ inches from the center, and 2 candles each 2.60 inches from the center.

$1 \times 0^2 = 0.$
$4 \times 2.25^2 = 20.25$
$2 \times 2.60^2 = 13.50$

$7)33.75$

4.82

That is; the average of the square of the distances of the candles from the center candle is 4.82.

Our 16-candle power light will require the disk to be placed at about 40 inches from the candles. Our 110-candle power light will require the disk to be placed about 20 inches from the candles. The square of the geometrical average of these two distances is 800, and the square root of this number is 28.284. If our average square of the distance from all the candles is 800, the square of the distance from the center candle to the disk will be 4.82 less, or 795.18, the square root of which is 28.199. That is, the candles should be placed .085 inch nearer the disk than the scale would indicate. If this is done the maximum error due to the candles being not at one place will not exceed one-fifth of 1 per cent. for determinations ranging from 14-candle power to 84-candle power. With a 112-candle power light the error would be one-third of 1 per cent. The cost of the candles burned for one test would be about 3 or 4 cents.

As there seem to be no serious disadvantages in using 7 candles it may be well to note the advantages. The greatest advantage is in eliminating to a great extent the fluctuations of individual candles. Of course, it is possible that a whole package of candles may not be satisfactory, and then it will be advisable to use candles from some other package. It is also an advantage to use a light as a standard that is large enough to allow the comparison disk to be used at a distance of from 2 to 3 feet from the standard light. Seven candles at a distance of 2 feet give a light equal to 1.75 candle at 1 foot distance. Seven candles at a distance of 3 feet give a light equal to .78 candle at 1 foot distance. Using a 60-inch bar with 2 candles, if the candle power of the gas is 16 the illumination on the disk will be equal to 1.17 candle.

The use of 7 candles as a standard permits of the direct determination of the illuminating value of lights of several hundred candle power, if a bar of sufficient length is used. I have recently had occasion to make tests of rather high candle power lights, and have used with considerable satisfaction a bar of variable length. The 7 candles with their balance are contained in a well ventilated box, 2 feet long, 1½ feet wide, and 2 feet high. To this box is attached a support for the sight-box, and along the support is the scale. The closest reading to the candles that is allowed by the construction is 2 feet, and the sight-box has a travel of 2½ feet. The light to be tested is contained in a box similar to the one containing the candles. Numerous screens to shut off outside light were provided. The lights can be placed only 7 feet apart, and then lights of less than 3-candle power can be tested. The lights may be placed the length of the room apart. When they are 16 feet apart, a light of more than 300 candles may be tested. Of course, it would scarcely be possible to have a scale, giving direct readings of illuminating ratios, for every length of bar, and so a uniformly divided decimal scale having its zero point at the center candle was used. As the extreme readings are scarcely more than an inch apart, it is not necessary to square each reading, but only to square the average reading when making the calculations for candle power. A slide rule is very convenient for making these computations, as it gives results of sufficient accuracy in a third or a fourth of the time required by logarithms or arithmetic. I can strongly recommend this style of photometer to anyone desiring to test lights of either a few candle power or of several hundred candle power.

A simplification of the ordinary procedure and subsequent calculations in candle power determinations which I do not remember having seen in print I think worthy of being brought to your attention. The formula for photometric determinations with candles is the following:

Average candle power observed—

$$\times \frac{\text{number of grains of candle burned per hour}}{120}$$

$$\times \frac{5}{\text{nunber of feet of gas burned per hour}} = \text{corrected candle power.}$$

This formula condenses to candle power observed—

$$\times \frac{\text{grains of candle burned}}{24 \times \text{feet of gas burned}} = \text{corrected candle power,}$$

the candles and the gas being burned the same length of time, which may be an hour or a tenth of an hour.

This formula may be transposed to the following:

$$\frac{\text{Candle power observed}}{\text{Feet gas burned}} = \text{corrected candle power}$$

$$\frac{\text{Grains candle burned}}{24}$$

To use this method there is required, besides the ordinary photometric apparatus, a 3-way cock that may be turned by the operator while observing the candle balance. One branch of the cock is connected to the gas supply, another one with a pipe leading direct to the gas burner, and the third connects with the meter.

The gas is passed through the meter and burned from the desired burner at the proper rate. The cock is then turned so that the meter is by-passed and the state of the meter is taken. The candles are lighted, and when they are burning properly the balance is adjusted so that the candle's end is somewhat the heavier. At the instant the pointer of the balance crosses the zero mark the 3-way cock is turned so that the gas passes through the meter. A weight is now added to the candle end of the balance and observations are made at the disk until the pointer of the balance again crosses zero. At that instant the 3-way cock is turned so as to by-pass the meter. The state of the meter is again taken and the difference between the two states shows the amount of gas consumed. The weight placed on the balance shows the amount of candle burned during the test. The only calculation required is to divide the average candle power by the amount of gas burned, sometimes using a multiplier, the quotient being the candle power of the gas corrected to a rate of burning of 5 feet per hour for the gas and 120 grains per hour for the candle. Of course, the amount of gas used should be corrected for temperature and pressure. The formula is correct for any length of time, but 6 minutes is probably the most convenient period. In 6 minutes 1 candle should burn 12 grains. If 12 grains of candle are burned the formula becomes:

$$\frac{\frac{\text{Candle power observed}}{\text{Feet of gas burned}}}{\frac{12}{24} = \frac{1}{2}} = \frac{\text{Candle power observed}}{2 \times \text{feet of gas burned}} = \text{Corrected candle power.}$$

If 24 grains of candle are burned, or 2 candles are used, the formula becomes:

$$\frac{\frac{\text{Candle power observed}}{\text{Feet of gas burned}}}{\frac{24}{24}} = \frac{\text{Candle power observed}}{\text{Feet of gas burned}} = \text{Corrected candle power.}$$

If 84 grains of candle are burned, or 7 candles are used, the formula becomes:

$$\frac{\frac{\text{Candle power observed}}{\text{Feet of gas burned}}}{\frac{84}{24}} = \frac{7 \times \text{candle power observed}}{2 \times \text{feet of gas burned}} = \text{Corrected candle power.}$$

It will be observed that there is no time observation required, but if required it may be taken by starting the stop watch at the instant of turning the cock at the beginning of the test and stopping the watch when the cock is turned at the end of the test.

The ordinary method of making the test requires 4 observations or readings to be taken to give the rate of burning of candle and gas; and if only 1 stop watch is used 2 of these observations consist in reading at the same instant 2 hands moving over 2 different dials. In the proposed method, at the beginning and also at the end of the test, a turn of the wrist is made when the eye observes that 2 marks coincide, and at leisure a reading is made of the position of the stationary hand on the meter dial.

The following example shows all the observations and calculations required with the method and apparatus described. The figures are from a test actually made:

Meter readings 0.650

Gas burned = 0.100 / 0.550

Temperature 71°

Length of bar used 12.00 feet

2.41	
2.37	
2.38	
2.36	Observed readings, in feet.
2.37	
2.35	
2.33	
2.37	
2.32	

Average = 2.34 / 2.36 = Distance of disk from candles.

12.00 / 9 64 = Distance of disk from gas flame.

$\left(\frac{9\ 64}{2.36}\right)^2 \times \frac{\text{⅞ } 1.03}{.560 \times 2} = 109$ = candle power corrected to 5 feet per hour.

The two following examples are from actual tests, except that the readings on the bar are given in candle powers instead of distances:

		Bar Readings
Meter reading,	4.586 (in feet)	28.7
" "	3.950 " "	28.7
		29.0
Gas burned,	0.636 " " at 72°	29.0
Tem. cor.,	.021	29.0
		27.5
Gas burned,	0.615 " " " 60°	27.5
		28.7
		29.0
Calculation:		29.0
		28.7
400.3 / .615 × 4 = 162.7 = candle power.		27.8
		28.7
		29.0
Corrected to five feet per hour.		400.3

The time of burning was 5 minutes and 36 seconds, as taken by a stop watch (=5.6 minutes).

Then $\frac{.615}{5.6} \times 60 = 6.59$ was the number of feet per hour that was burned. Also $\frac{400.3}{14} \times 7 \times \frac{6}{5.6} = 214.4$ was the actual candle power observed.

It will be noticed that instead of multiplying the average reading by 7 and dividing by 2, 14 readings have been taken and their sum divided by 4. The distance between the lights was 15 feet.

In the following test the distance between the lights was 8 feet. These figures may be taken as illustrating the test of an ordinary gas when burned from an Argand burner.

		Bar Readings.
7.472 =	Meter reading in cubic feet.	2.45
7.000 =	" " " " "	2.42
		2.48
.472 =	Gas used at 69° " "	2.45
.012 =	Temperature correction.	2.42
		2.37
.460 =	Gas used at 60° in cubic feet.	2.42
		2.48
		2.52
		2.45
		2.37
33.97 / 4 × .460 = 18.4 = Candle power, corrected		2.40
to 5 feet per hour.		2.37
		2.37
		33.97

Discussion.

The President—We will be pleased to hear from Mr. Jenkins, the Massachusetts State Inspector of Gas.

Mr. Jenkins—Mr. President, the latter part of Mr. Hinman's article, in regard to this novel method of taking candle power, appeals to me as being rather a neat way of doing it. An objection that appeared to me is this: Unless we use the stop watch occasionally, to take the time of the candles' burning, there may be an inaccuracy from the balance. In the new way, if the balance is inaccurate, of course, the determination would be thrown out. If the balance is working accurately, and the candles are burning within the ordinarily used limits of burning, it would seem to be a very neat way of making candle power determination. Possibly it would not be well suited for works' use, but I think it would be for office use. Where you make a number of readings of a meter with stop watches you are liable to make errors in your calculations. In regard to using the 7 candles' standard for high candle power testing, it seemed to me that so long as the candle is the ultimate standard for even high candle power observations it would be well to use 7 candles, or any other number of candles, directly in the measurement, as to use some secondary standard as, for example, an Argand burner. I remember making some tests of electric arc lights. We first tested with one candle against an Argand burner with blue chimney—the colors of the lights were very different—and then with the blue chimney Argand standard against the electric light, and the colors were then again dissimilar.

On motion of Mr. Africa a vote of thanks was passed to Mr. Hinman for his paper.

The President introduced Mr. George F. Macmun, Jr., of Marlboro, Mass., who read the following paper on

GAS ENGINES.

Mr. President and Gentlemen: This paper relating to gas engines is for the purpose of narrating my experiences and observations, in which I hope may be found some ideas that will be useful to those who have occasion to come in contact with gas engines; also, for describing the difficulties I have encountered with engines of various types, and the methods for correcting same, and the outlook of the gas engine as a reliable, economic and satisfactory source of power in cities and suburbs that have and know the intrinsic value of this rapidly spreading and invincible factor, gas.

The gas engine received its success from Dr. N. A. Otto, who constructed and marketed the first engines to give satisfactory results. Others have since been placed upon the market that give high percentages of efficiency; still, there are others that have gained the prejudice of many engineers. These come from the persons who look for the lowest priced engines they can find, and taking for sufficient guarantee, without regarding or consulting experts to investigate the construction, the oily tongues of the many salesmen who claim their engine is the best. Good advice is to pay your money for the best engine there is according to expert testimony and the reputation of reliable manufacturers.

The principle of the 4-cycle engine which is generally in use is understood by most gas engineers. It requires 2 revolutions of the crank shaft to complete the operation of one impulse, or 4 cycles or strokes divided into the suction on the outward stroke, compression on the inward, ignition taking place just before the end of the stroke is completed, which gives a lead to the final explosion of the mixture just sufficient to bring the point of maximum pressure at the beginning of expansion stroke, then the expansive and exhaust strokes. Thus the same operation is continued in succession while the engine is under full load.

A modification of the 4-cycle engine was produced by Mr. Dugald Clerk, in the '80's. This engine used a pump for forcing the mixture into the cylinder under pressure just at the end of the expansion stroke. This eliminated the suction and the exhaust cycles. Clerk's engine was the pioneer of what is now known as the two cycle, or engine which completes its operation for one impulse in one revolution.

Modern 2-cycle engines are after the principle of the Day type. Its crank shaft and piston end are incased, forming a chamber wherein the charge is mixed and forced into the cylinder at a sufficient pressure. On the inward stroke the piston draws in a charge of gas and air through a check valve in the side of the chamber; on the outward stroke the mixture in the crank chamber is compressed to a pressure of about 4 to 6 pounds to the square inch. As the piston uncovers the inlet port, which is a tube connecting the crank chamber with the cylinder, placed externally, the pressure drives a portion of the charge into the cylinder, which is compressed on the next stroke of the piston, ignition taking place at the best point to obtain the highest efficiency, about 5° below the center. The piston is then on its expansion stroke, when the products of combustion are expelled by the fresh charge forcing its way through the uncovered port.

Summary for each impulse: There are 2 operations, 2 in the cylinder, and the other 2 in the crank chamber, completing the work in one revolution. The difficulties that may occur to an engine, while it is in operation, are not always determined by a slight observation, and a set of rules cannot be accurately made to cover all engines, as the mechanism varies with the types. Principally the primary troubles with the gas engine are failure to start, loss of power, after engine is in use a year or more, explosions in the exhaust port, and premature explosions. There are several other minor troubles of small importance which can be found easily.

Considering, first, the starting of an engine. This point, in some gas

engines, is a subject for continual discussion, and is the searchlight of criticism. As previously stated, it derives its circulation from the users of inferior engines.

When an engine fails to start, the first point is to determine which portion of the mixture is in excess of the correct proportion. Closing or opening the gas valve, or choking the air on engines that have the gas valve opened by vacuum, allows a larger draught of gas to enter the cylinder.

Engines with the hot tube type of ignition fail to start occasionally by the accidental shifting of the air shutter causing an imperfect combustion of the gas which elevates the lowest point of incandescence on the tube, and consequently the distance of ignition is increased.

An engine in this condition operates with an unnecessary waste of gas, loss of power, and frequently a secondary firing in the exhaust pot or pipe. The temperature of the tube when below its standard, which is approximately 1,650°, for perfect operation of the engine, is the prime basis for the conditions given above, which are very easily corrected by the simple adjustment of the air shutter.

In the present era the best methods for ignition are either the make-and-break type of electrical device, or the jump-spark in connection with the Ruhmkorff coil. Almost any electrical device for exploding the gases is more positive than the hot tube, and inexpensive in comparison to renewals of tubes and cost of gas for heating, to cost of battery replenishments.

An incident worthy of mention which I experienced quite recently was the improper location of electrodes in a certain engine that proved to be the greatest bulk of annoyance that I ever encountered. This particular engine had its electrodes in the exhaust passage, which I think you will all agree is not the correct location for contact points in any engine. If the contact points are to be placed in any of the ports, I think a preference would be given to the inlet port, as the temperature of the points would be kept cool by the continual draught of gas and air.

Moisture was the seat of continual annoyance with this imperfectly designed engine. It is a known fact that moisture will collect in any vessel that is exposed to a raise or drop in temperature. The same conditions prevailed with this engine. In the morning when the engine was to be started moisture would collect from the rapid rise in temperature caused from the first explosion of the gases in the cylinder, which had adapted the temperature of the atmosphere over night. When the exhaust valve opened, this collection of moisture was carried by the electrodes, consequently causing a short circuit, in which all the current supplied by batteries was consumed, leaving the contact points without sufficient current to create the spark; and taking off the igniter plate was always in the programme for starting this engine. Another feature in the mechanism was the vacuum inlet valve, which I found took a large margin of gas per horse power.

Starting the gas engine is considered by some users of gas engines a task to which they are occasionally unequal. I have found operators who have motors that run at their will. These men start up hurriedly in the morning, throw a little oil at their machine and, positively speaking, the engine is left running until time for shutting down without any attendance. The very best engines built to-day will never work to advantage while the numerous men of this stamp operate them.

Now, when a man understands his motor and gives it the necessary attention, such as cleaning, oiling and examination of the points to remove any possible accumulation of carbon, he has mastered the common secret of successful operation.

Lost power is usually experienced after a period of use by some engineers. This is caused by a liberal supply of oil which carbonizes on the valve seat, and in consequence part of the compression is lost and the power developed is reduced in proportion to the leakage.

The quality of the lubricant for the cylinder, if not specially made, will create this lost power at an earlier period than with the use of high test mineral oils. Proper oil for use in cylinders is a thin lubricant that will not carbonize under high temperatures.

A method for obviating this carbonization is to place a tapping over the valves exposed to high temperature. Insert an oil cup and fill with kerosene to be run in once a week while the engine is in operation, or an oil can to squirt little kerosene on the valves and stems. This will cut every particle of carbon from the valve seat.

Explosions in the exhaust passages were fully covered under article on hot tubes' ignition. I might add that unexploded gases in the cylinder collect in the exhaust pot, and when of sufficient amount ignite. Premature explosions, commonly called back firing, occur from various causes. Gases rich in hydrocarbons, overheated cylinders, imperfect timing of ignition apparatus, or too high compression; finally a collection of carbon in the cylinder becoming incandescent.

Heat is a great factor in the gas engine. Loss of heat is occasioned by the escape from the cylinder of the mixture at a high temperature. It is clearly essential to develop all the heat of which the original combustible gas is susceptible. This is obtained by complete combustion, which depends upon the method of mixing with air and igniting. Such are the requirements for good service in gas engines.

Gas engines have many points of resemblance to the steam engine. In one as in the other it is the expansion of a gaseous fluid which originates the work of the engine. Whatever the nature of the fluid, its elastic force is employed to move the piston. This fluid, then, is only an intermediate agent employed to convey heat, and giving up a portion during the process of transportation, the heat which disappears is converted into mechanical work and is the source of power in the motor. This corelation of heat and motion is one of the most beautiful conceptions of modern science.

In the steam engines, heat is first employed in converting water into steam, and augmenting the heat of the steam. The vaporization is effected outside of the cylinder; that is to say, in the boiler and sometime before the steam acts upon the piston.

It is quite otherwise with the gas motors; for in these the heat is developed within the cylinder and in the midst of the gasous mass and only at the moment power is wanted. As there is no storing up of its heat or any transportation of it, these causes of losses are avoided. The advantages of such a mode of production and utilization of heat are apparent. In the steam engine the time of firing up, of evaporating the water, and of raising the steam to a proper temperature is necessarily consumed. In the gas engine it is only required to admit the mixture by a single turn of the stopcock. Furthermore, the gas engine consumes fuel only while it is doing work. In this quality it possesses a great advantage over other heat engines and in those branches of industry which require any application of power. In all industries which require any amount of motive power the use of the gas engine is extending daily.

The fact that it is ready at a moment's notice, without the delay caused by lighting fires and getting up steam, or the expense of keeping up the pressure during intervals of work, and the small amount of attendance and its impossible danger from explosions, are some of the reasons that specially recommend it. On the other hand it has been long enough in use to enable practical men to decide on its durability.

To attain success in the introduction of engines, gas companies should employ a man who can talk engines with ease. The gas stove business has been pushed with remarkable success; why not exert the same amount of energy in the gas engine direction? It surely is as profitable, as the field for engines of all sizes is an expansive one.

Discussion.

Mr. Woodward—We have listened to a most valuable and interesting paper, and while it may not admit of much discussion here, it is one that can be taken home and studied, and a good deal of good, sound, practical information gathered therefrom. One of the bugaboos about a gas engine in my experience has been some difficulty in starting it. I have often been called up early in the morning to remedy this trouble with a gas engine. It is all treated very nicely in this paper. I think Mr. Macmun is entitled to a most hearty vote of thanks for his very valuable and interesting paper; and I so move.

The motion was seconded and adopted.

REPORTS OF COMMITTEES ON OBITUARY RESOLUTIONS.

The following reports from the committees on obituary resolutions were read and received, and copies thereof were ordered sent to the respective families of the deceased:

George B. Neal.

George B. Neal, one of the original members of this Association, died on the 7th of July, 1901, in the 78th year of his age. His connection with the gas industry dates from 1852, when he was elected Clerk and Treasurer of the Charlestown (Mass.) Gas Company, which office he held continuously up to the time of his death.

In 1875, he became prominently connected with the Lynn (Mass.) Gas Company, and in 1877 he was chosen Managing Director. He was also identified with the Somerville (Mass.) Electric Company. He was the first Secretary of the New England Association of Gas Engineers, and served it 13 years. In 1884 he was elected a member of its Board of Directors, and served 4 years. This Association had its inception immediately after the funeral services of the lamented George Barnard Blake, who was at that time Mayor of the city of Worcester, and also Manager of the Worcester Gas Light Company. His death resulted from injuries received through an explosion in the purifying house at

the gas works, in December, 1870. With the formation of this Association, Mr. Neal was actively identified, and its success has been largely due to his wise foresight and business ability. He became a member of the American Gas Light Association in May, 1874, and served as Second Vice-President 4 years, and also on various committtees. He was made a member of the Guild of Gas Managers in December, 1881.

His was a marked personality. In all his connections with the several Associations and gas companies he was prominently identified with their deliberations and active in debate. His example, as a member of the various Associations and as a man, wherever he was known, was worthy to be emulated. His presence at the meetings of the Associations with which he was connected will be sadly missed, and his consistent and upright life will continue in pleasant memory for a long time to come. Signed, F. C. Sherman, Henry B. Leach, Patrick Coyle, } Committee.

David W. Crafts.

Whereas: The Creator, in His Divine wisdom, has called, in the fullness of his years, our friend and comrade, David W. Crafts, to his eternal home, we hereby take this opportunity to express our appreciation of our loss, and also of him as a man and associate. He set an example that many a younger man might emulate to advantage. He was most enthusiastic in his love of his profession, and untiring in his devotion to his work. While one of the oldest members of this Association, and one of the oldest men in the gas business, he was always up-to-date in his ideas and methods.

He was the friend of all—the old and the young; and while constantly seeking information from others, he was always ready to impart to them of the store of knowledge and wisdom he had acquired during his long and varied experience. Genial and kindly hearted, his passing leaves a vacancy upon our rolls that will long remain with those who knew and loved him best. Respectfully submitted,

H. F. Coggeshall, W. H. Snow, F. S. Richardson, } Committee.

Frederic C. Blood.

Mr. Frederic C. Blood, a member of this Association, died at his home, in Ware, Mass., on Feb. 24th, 1901, after a short illness.

Mr. Blood was for nearly 20 years connected with the Otis Company of Ware, and had under his especial charge the gas department of that Company's business, which he conducted with success.

Mr. Blood was a man of attractive personal qualities. His death is deeply mourned by his many friends and by his fellow members of this Association. Signed, S. J. Fowler, J. J. Humphreys, Jr., Z. M. Jenks, } Committee.

Votes of Thanks.

The President—Has anybody anything else to offer for the good of the Association?

Mr. Allyn—Mr. President, I would like to offer just one thing: That the thanks of the Association—I address this to the Secretary—be tendered to our retiring President for the able, energetic, courteous, businesslike-manner in which he has performed his duties as presiding officer of this Thirty-second Session of the New England Association.

Mr. Addicks—Mr. Secretary, I would like to second that motion, and to thank the President for giving us a meeting so full and running over with good things, both at the meeting and at our banquet. There are those who have held the office that realize fully how much work it entails and how much thought is required by the President.

The motion as put by the Secretary was adopted unanimously by rising vote.

The meeting was then declared adjourned.

Address of the President (Mr. Henry L. Doherty) of the Ohio Gas Light Association, Delivered on the Occasion of its Eighteenth Annual Meeting, Columbus, Ohio, March, 1902.

I know of no unusual developments in the gas business during the past year. Much progress has been made, but it has not been of a sensational character. There has been a healthy growth toward a better understanding of the business, rather than the adoption of better operating methods. Tracing through the various steps in the manufacture of gas, the following points of interest occur to me: In large works a considerable saving may be accomplished by machine stoking, and labor troubles may be thus avoided to a great degree. From results obtained in European gas works, it would not seem improbable to suppose that we can save from 5 cents to 7 cents per 1,000 cubic feet on this item alone, in works having an output of 2 million feet or more per day.

It has been demonstrated that the washing and scrubbing of gas can be effectively done without the use of mechanical scrubbers. The improper distribution of water in tower scrubbers has had much to do heretofore with the ineffectiveness of this form of apparatus. By flooding the contents of the tower scrubber, very effective results can be obtained. Several methods for the intermittant introduction of a large quantity of water are now in use. A simple form of this apparatus can be found illustrated in the Wrinkle Department of our last proceedings. I doubt, however, if tower scrubbers will ever succeed in rivalling the new brush scrubbers, which are now yielding ammoniacal liquor having a strength in excess of 25 ounces. Condensation can sometimes be greatly assisted by water cooling towers. Water used for condensation can be taken at atmospheric temperature, and cooled by air to temperature lower than the air used for cooling, provided that the air is not close to the saturation point. The temperature of the condensing room sometimes approaches 100° F. in the summer time, and we have to resort to the use of cold water, which might not always be obtainable, or else we must cool this water below the atmospheric temperature by evaporation. Purification is now largely a problem in investment. The use of a small positive blower belted to the exhauster is a very satisfactory and effective means of constant revivification of iron oxide.

Several new proportional meters are now in the course of development, and I am confident we will some day have a satisfactory substitute for the big, cumbersome, wet station meter now generally in use.

The increased sales of fuel gas have relieved the necessity for large holder capacity. In the case of one gas company with which I am acquainted, the rate of sendout is so uniform that the height of the holder does not vary greatly throughout the 24 hours, except between 10 o'clock at night, and 6 o'clock in the morning. Another company which has a large sale for fuel gas now has an annual output of 288 times its maximum daily output.

Water gas making is so largely a problem dependent upon the oil market that little is left for interesting comment. A great saving, however, can be made in fuel, by the use of a higher blast pressure, which will give you a higher velocity in your fuel bed, and result in a much larger production of CO_2 during the blast, which means that you get more of the heat of your carbon in the fuel bed where it is most needed, rather than in the carburetor and superheater where you now have an excess. Your blowers and piping should be of sufficient size and so constructed that you can get, if necessary, a 20-inch fall of pressure between the bottom of your grate bars and the top of your fuel bed.

Two or three companies with which I am acquainted have adopted iron meter connections, and we think them an improvement on lead.

Considerable development has been made in the last few years in large gas engines. The adoption of these large gas engines by big power users cannot but prove advantageous to the development and use of the smaller gas engines In one city several gas engines are used in isolated electric light plants, purchasing their gas from the gas company. I expect to see the ordinary steam engine largely superseded by internal combustion engines during the next few years.

Residuals.—No particular complaint exists at present on the prices received from residuals, but I do not think we are getting all that we might get from these residuals, and especially from our ammonia. Large quantities of anhydrous ammonia are used in every city for refrigerating purposes, and the users pay approximately 25 cents per pound for it. The market for aqua ammonia is practically unlimited. It is a desirable substitute for soap, and it is also a most desirable fertilizer for quick results. I think there is scarcely a town in the country that could not use all the ammonia produced at the local gas works in the form of aqua ammonia as a substitute for soap and as a fertilizer for lawns and plants. It is the only fertilizer which will give almost immediate results.

I think nothing offers any greater opportunity for increasing our earnings than the proper handling and marketing of coke. In Denver we have heretofore found it almost impossible to sell our coke at a price which would net us $2.75 per ton in our yard. During the past year we have made the matter of handling coke a department of itself, under the direction of a former employee in our soliciting department, and by advertising, careful treatment of coke consumers, prompt deliveries and proper screening, we have now developed a market which takes the coke faster than we can make it, and it will net us in the yard more than $4 per ton. This subject will also be treated by discussion at this meeting.

The Programme for this Convention.—We have this year made a radical departure from our programme methods. We believe that the discussion of important subjects at our convention will create more interest at our gatherings and prove more beneficial to our membership. It is presumed that this programme method will be repeated, if it meets with the approval of the members, and it is reasonable to suppose that it can be made more effective at subsequent meetings. There are many important problems which confront the gas fraternity, but we have not tried to include them *all*. It is also difficult to determine what subjects are of the most importance to the greatest number. Every member of this Association should feel in a measure responsible for its success, and

by simply requesting discussions of such problems as you happen to be interested in, you will do much toward the success of these meetings.

The Advantage of Dividing Association Work—There is probably no other business in the country which is so thoroughly organized, and in which co-operation without co-ownership exists to the same extent. If the various Gas Associations have done nothing more than to bring the men of this business in contact with each other, they have accomplished enough to have fully warranted their existence. Gas Associations have done more than this, and have had a most potent influence on the development of this field of industry, but there is more work still to be done than has already been done.

New Gas Associations are constantly being born, and while many of our oldest are well organized and equipped, it seems to me the next step toward securing useful work by these Associations would be some harmonious plan of co-operation whereby the work would be so divided that a smaller field could be covered by each, and this particular field better covered. Up to the early years of the last decade our Gas Associations seem to have been devoted almost entirely to the consideration of engineering problems, but in the latter half of this decade a pronounced change has occurred, and we find the Associations have drifted almost entirely into mercantile organizations. This fact has called forth many lamentations from the old school of gas engineers. They complain bitterly that the present gas manager is no longer a manufacturer but a merchant, and that the new school has neither the time nor the interest for any other problem than the sale of gas. It seems to me that both are wrong in a measure. The gas business is not strictly a manufacturing business, nor is it wholly a mercantile business. To devote all of our time to one branch and none of our time to the other must necessarily be a mistake, and we should devote our time to these two branches in proportion to the necessities and possibilities which each branch presents.

Personally, while I may admit that the manufacturing or engineering end of our business is still in a crude shape, I believe that, generally speaking, a given amount of time and a given amount of investment will bring larger returns if bestowed upon the commercial side of our business than it will bring if devoted to the engineering side; and after all, we are in the business to make our plants the most productive for an indefinite period.

When a plant is too large for one man to conduct both the engineering and commercial sides, the two branches should be separated; and when our Associations are confronted with too many problems to give to each the careful consideration due it, the field of their work should be contracted, or divided, to enable each to cover its chosen field in a creditable manner. We now have three Associations which are national in their character: The American Gas Light Association, the Western Gas Association, and the Ohio Gas Light Association. Besides these three are sectional organizations, such as the New England Association of Gas Engineers, and the Pacific Coast Gas Association; and there are also numerous State organizations. We have not a single Association which devotes itself entirely to engineering work, and I believe such an organization is badly needed. There are already so many organizations that it seems unwise to suggest the formation of additional ones, but it has often occurred to me that a great step would be accomplished in our organization work if one of these larger Associations could be devoted strictly to engineering work and another one of them devoted strictly to commercial work.

While I am a member of all three of the larger Associations, I have heretofore taken so little part in the affairs of the American Gas Light Association and the Western Gas Association, that I hesitate to suggest any change in their methods, as in some people's minds a suggestion aimed at improvement carries with it an implied criticism; but I am anxious to illustrate the point I am trying to make regarding the organization of Gas Associations amongst themselves, and for this reason will presume upon the generosity of the gas fraternity to point out the advantages which may result from a division of their work. Let us assume that the American Gas Light Association should hereafter devote itself entirely to engineering work, and the Western Gas Association should devote its time entirely to commercial work. This would tend to change the membership of these two Associations, until eventually we would expect to have one organization composed entirely of engineers and the other almost entirely of commercial men. It is reasonable to suppose that every gas engineer in the country would eventually affiliate with the American Gas Light Association, and that all of the commercial men would later be affiliated with the Western Gas Association. Both would then enjoy a more cohesive membership, that could unquestionably render more useful service, and greater vim and interest would characterize their conventions.

The effect on the gas companies would be equally beneficial. Gas companies are rapidly drifting towards special managers of each department, and the engineering executive of a gas company cannot cover all of the engineering subjects treated at a convention without attending them all, and he is compelled to stay through or "loaf" while problems in accounting and other matters are being discussed, all of which he does not understand, or in which he has no interest. These same arguments are applicable to the man in charge of the office, or other work not in the line of engineering, and this man must either stay through the discussion in which he has no interest, and which he does not understand, or he must drift from the convention hall and amuse himself in some other manner while subjects of an engineering character are being considered. This condition has a disintegrating effect upon our conventions. We also have another serious difficulty which confronts two men coming from the same company. One may be the engineer and the other the secretary, and both of them may not be able to absent themselves from their duties simultaneously, while, if one Association were devoted to engineering work and another to commercial work, the attendance of the proper man would always be assured and much interest would be added to the convention proceedings.

I think it of great importance that we should have some organization amongst the gas fraternity similar to the Institute of Electrical Engineers, which would devote its efforts exclusively to engineering and research work; and if some portions of such work cannot be accomplished by the present Associations, I believe it would be highly beneficial to the gas business as a whole if an Institute of Gas Engineers should be formed. The memberships of these three organizations are nearly identical; few of the members, if any of them, belonging to but one organization, and many of them belonging to all three.

What Should the Future Policy of this Association be?—The Ohio Gas Light Association is in a very unique position. A large portion of our membership comes from beyond the border of our State, and it cannot be classed properly as either a state organization or a national organization. The character of this Association must be determined upon by its members, and some definite plans for its future decided upon. It was formed as a State organization. Its membership is largely composed of managers of small plants, who must spread themselves over the entire field of gas manufacture, distribution, accounting and the development of new business. The original object of this Association was unquestionably the benefit of the managers of small gas companies, and in justice to them this Association cannot take up a special field of work unless the membership should unanimously be in favor of such a proposition. I earnestly hope that the members in attendance at this convention will express themselves on this point. If it is their desire that the Association be made national in its character, I would suggest the appointment of a special committee to confer with the officers of the other two large Associations and determine whether some special work could not be done by each of these three organizations, if their work should be divided, and to determine whether such division could be made as would be mutually agreeable to all.

Affiliation with Other Engineers.—I also think that gas men should bring themselves into closer relationship with other engineers. They have so isolated themselves that gas engineering is not recognized as a profession, and many of the terms we use, which should be common to all branches of engineering, are different in their meaning from those adopted by other more generally recognized branches of engineering. To illustrate this, we might take our definition of a candle-foot. This to us means certain quantity of illumination, while to all other branches of engineering a candle-foot means the unit of intensity. To us a candle-foot is the product of yield times candle power, and to obtain a standard quantity of illumination—namely, a candle power hour—we must divide this product by 5; hence it seems to me that the term candle-foot, as we use it, should be discarded to prevent misunderstanding. It seems to me we should adopt as our unit of quantity of illumination the candle power hour, which means the quantity of illumination of a standard candle burning 1 hour; and as our standard of intensity we should adopt the candle power foot which is used by other branches of engineering, and which is interpreted to mean the unit of intensity of light 1 foot from a standard candle. By affiliation and harmonizing with the other branches of the engineering profession, we can hope to receive beneficial results. For instance, our work has almost entirely been confined to the manufacture of illuminating gas, but I believe the time is fast coming when we will find it to our advantage to manufacture a cheap fuel gas for firing our benches and for power.

Producer Gas Firing.—The engineers in steel works and glass factories have devoted much time to the solution of some of these problems, and some interesting data can be found in the proceedings of other

engineering associations. It makes me feel a bit cheap to go into a steel or glass plant and find them successfully using gas for firing their furnaces, and testing and determining the constituents of their gas with a dexterity almost unknown in a gas works, and yet we gas engineers seem to like to boast that we cannot make a fuel gas suitable for use, and cannot use it after it is made. This subject will be touched upon in our proceedings.

Selection of Employees.—I think every gas company should be more careful in the selection of its employees. Many branches of work can employ men who have been specially trained for their engineering positions, and while this is hardly possible for the gas business, yet we can hire men who have the necessary education, and these we must teach for our particular business. We are running a business and not a school, and it seems to me highly important that where possible we should hire men who have been educated for general engineering work, and not men to whom we must teach the very rudiments of arithmetic in order to fit them for the problems which they must solve every day to improve our operating efficiency.

Fuel Gas and Gas Appliances.—I consider fuel gas, in its universal sense, to be out of the question, or at least until some method for the cheap production of oxygen shall have been found. While a field of enormous dimensions already exists, the acquisition of this business rests almost entirely with the wisdom and ingenuity of the designers of our fuel gas appliances. The sale of gas at $1 per 1,000 cubic feet for heating purposes which contains 650 B.T.U., is equivalent to selling heat energy at about $1.54 per million B.T.U., this in turn being equivalent to about $53 per ton for good bituminous coal. To make a reduction in the selling price of gas which would even in a measure compensate for this vast difference in cost to the consumer of heat energy is simply out of the question, and our only hope lies in perfecting our fuel gas appliances.

Our gas appliance business is in a crude condition, in spite of the fact that so-called satisfactory results are often obtained with most of the appliances which we use. Satisfaction after all is a relative matter, and we should aim to have the best rather than to have something which is merely a little better than was used a few years ago. I have never seen any tests of fuel gas appliances which were at all comprehensive or conclusive. Enormous opportunities for inaccuracies always exist, and the work has generally been done by men who have not taken the trouble to study the laws of heat and combustion. While it is generally an accepted fact that every fuel gas appliance has some favorite rate of gas consumption at which most economical results will be obtained, yet none of us has ever made this a subject for special research work, or at least not to my knowledge. I might cite as an example our present water heaters. I not only criticise their manufacture, but I also criticise their method of installation. I know of nothing which would so increase our business as our ability to obtain and install a water heater which would have a working efficiency beyond that now obtained, but which is not impossible with the present existing prices of gas and the knowledge of the engineering problems involved. At present we must contend with several causes of inefficiencies in independent water heaters, as follows:

Different rates of gas consumption; irregular draughts and radiation from boiler and piping, and radiation from water heater when not in use.

Radiation from boiler and piping can be partially prevented by an insulated covering on the boiler. Irregular draughts can be practically overcome by the use of a broken length of fuel pipe with a canopy above it. The draught in your chimney must constantly change, due to the intermittent use of the water heater, or due to other appliances using the same or adjacent flues. If the draught is excessive, more air is drawn through the heater than is needed to support combustion, and the heat absorbed by this excess air is net loss. As the flow of gas varies only as the square root of the pressure, and not directly in proportion to changes of pressure, the efficiency of the heater is not much affected by a slight change in pressure, and we could obtain fairly economical results if the heater were so arranged that whenever it was turned on we would get approximately the most favorable rate of gas consumption. This could probably be done only by the use of some sort of stop cock which could only be in the position of "full on" or "entirely off." Radiation from the heater itself is a serious matter, since being connected with the flue it continues to induce a draught even after the gas has been turned off, so long as the water is at a temperature higher than that of the air. This causes cold air to come in contact with the coils of the heater, and as soon as the water contained in these coils is cooled it drops to the bottom of the heater, and the hot water comes over to take its place and in turn is cooled and drops to the bottom. If you will stop to think for a moment you will see that the circulation in your heater reverses when you turn off the gas. I think this loss could be most easily prevented by so arranging a gas stopcock that both the gas and the water will be turned off and on at the same time. With such a stopcock on the water pipe, no circulation would take place, and only the heat contained in the water in the coils of the heater would be lost. I cite this merely as an example. The same general criticisms are applicable to almost every other appliance which we use. A good water heater would not only give us the gas consumption of that water heater, but would put hundreds of gas ranges in constant use. Cheap gas stoves for the heating of rooms have materially curtailed our opportunities in this line. A gas heating stove, to be extensively used in an ordinary climate, must have a flue pipe which will discharge out of the room the vapor of water and the CO_2, and as little as possible of the heat generated by combustion. I am not afraid that our combustion is not complete, and I see no particularly harmful effect from a much larger percentage of CO_2 in the air than we are likely to get, but I am afraid of water vapor. CO_2 is as inert as nitrogen, and if any CO is produced it is in too insignificant a quantity to be considered. I doubt if the burning of 50 feet of gas per hour in a room, in even a very crude heating stove, would produce as much CO as would result from the smoking of 1 cigar.

I think we must change our methods to make ordinary gas heaters satisfactory. I think that eventually we will aim to develop the maximum quantity of the heat of the gas in the form of radiant energy, which travels without regard to the laws of gravity, which can be directed and controlled, and which warms the body and the furniture without expending itself entirely on the atmosphere of the room. To get a large percentage of radiant heat we must burn our gas at a high flame temperature, and direct the heat of the flame on some medium which will enable it to give off all excess heat in the gas above a certain temperature in the form of direct heat rays. This result could probably best be arrived at by the use of recuperative flues, which will deliver the heat in the outgoing gas to the incoming air and gas.

Desirability of Developing our Market.—I do not want to omit to answer in some way the charge which is frequently made that the engineering branch of our business is falling into neglect, owing to our entire efforts being devoted to the problem of selling gas. I do not think this charge is well founded, and I think none of us are more anxious to sell gas than is warranted in the light of recent experiences. It is not a difficult matter to double the earnings of a company by developing the market, and it most certainly is impossible to double the earnings of any ordinary company by improving its operating conditions, no matter how much time and money are so expended. Another thing which must not be overlooked, is the possibility of reducing our costs per 1,000 by increasing our sales. I might cite an instance of two gas companies with which I am reasonably well acquainted, both paying about the same amount of taxes and interest on the intrinsic worth of their property. The first company has extensively developed its gas market and its charge per 1,000 for taxes is about 2.7 cents, and for interest approximately 22 cents, while the second company has not developed its market so extensively and its taxes amount to about 10 cents per 1,000 cubic feet sold, and its interest charge is about 47 cents. By doubling the sales of gas this latter company can diminish its cost per 1,000 to 28 cents, and I know that no such saving is possible in the manufacturing end of the business.

Money judiciously expended on fuel gas campaigning can be made to pay 100 per cent. on the investment, and we can afford to spend much more on such a campaign than we have heretofore believed was possible. If a fund of 15 cents per capita is provided for the first year's campaign, the earnings from the increased consumption due to this campaign will keep up the work indefinitely, provided the money is judiciously expended. Personally, I do not believe in free service pipes, I do not believe in giving away gas stoves, and I do not believe in selling gas stoves at cost. I think the problem which confronts us is one of how much money we can afford to spend to increase our consumption, and how can this money be expended to give the greatest increase in consumption. I believe that the greatest increase in consumption can be obtained by expending this money to make people want stoves, and I also believe that you can make these people help carry along your campaign, when once you have made them want a stove, by paying you more than it cost you. There is a general and prevalent idea in the gas business that the main reason why people do not use gas for cooking is the obstacle of first cost. Now, if this reasoning is proper and sound, everybody in town where gas stoves are free would immediately put in a gas stove, and yet in some towns where stoves have been given away there are not as many in use as where they have been sold. This fact is

unquestionably an absolute proof that the main obstacle in putting gas stoves in use is not their first cost. The question of how to make peopie want stoves is one largely of opinion. I think, as a general proposition, and with the proper funds at your disposal, it is safe to work every avenue that you do not think ineffective. In other words, take advantage of every opportunity that offers, even though it might be unpromising. Time will be apt to demonstrate the worth of every opportunity at a small cost.

Personal solicitation always seems to be most effective, but advertising is really another form of solicitation, and your solicitor may not be able to get an audience with people that your advertising will reach. I never heard of anyone buying a stove on advertising alone, and yet I am confident it is impossible to get superlative results without advertising. I believe daily newspaper advertising is the best of all local advertising, and it is a simple form of solicitation that is methodical, cheap, systematic and persistent. Your advertisement is a written solicitation, and presumably written by an expert. It can approach people whom you cannot reach in person, can enforce attention without irritation, appeals to your prospective consumer in all sorts of humors and in all stages of "business," and if persistently followed up will some day strike that prospective consumer when he is in a receptive mood, and he will at least give your solicitor an interview when he next calls. While, as previously stated, I do not think it possible to stop the practice of putting in services free when once it has been established, yet where services are being put in free, every protection should be taken to reserve their ownership by the gas company, so far as this is possible.

Uniform Accounting.—Uniform accounting would also greatly benefit the gas fraternity. A committee of the American Gas Light Association has recently issued a report which is very comprehensive, and I advise you all to obtain a copy of this and acquaint yourselves with its recommendations. The advantges to be gained by uniform accounting are too innumerable to even mention. The most important is the facility it affords for different managers to compare their costs for the same class of work, and thus determine whether they are on a favorable basis as compared with others.

The Publication of Our Proceedings.—I also feel that some effort should be made to publish our past proceedings in convenient form, and to publish our proceedings hereafter each year. At present the funds of the Association will not warrant this additional expense. There are several methods open to us for the acquisition of these funds. One would be to solicit a greater membership amongst the gas men from all over the country, and I believe the appeal would be liberally responded to, if we made it plain to them that it was necessary to have their support to enable us to publish our proceedings. Another way would be to raise our dues. I am not, however, in favor of this, as I fear we might drive some of our members from the Association, but I think there are many of us who would be willing to contribute at least $10 instead of $3 per year, as the dues are now, and we could divide our members into two classes, known as the contributing membership and the ordinary membership. No distinction would be made between these two classes of members, except that the members of the contributing class would pay $10 per year, while the dues for the others would remain as at present. Published proceedings always make an excellent avenue for advertising, and this opens up another possible plan for obtaining the funds for the publication of our proceedings. I would suggest that a committee be appointed to consider the means for raising funds for the publication of our proceedings, and also to direct how these proceedings shall be published, and that such committee be instructed to report at our next annual meeting.

Differential Rates.—During the past year there seems to have developed a tendency to consider the sale of gas for illuminating and fuel purposes at different rates as illegal discrimination. If this contention should be sustained by a court of high jurisdiction, I fear its results to some gas companies would be almost disastrous. No matter what our private opinions may be regarding the equity, legality and desirability of differential rates, we all must agree that we should be free to act as we consider best, and not be hampered by any unfavorable limitations. I, therefore, hope that all of you will contribute every suggestion possible to the demonstration, beyond question, of the justice and legality of differential rates.

The Appointment of an Editor to Report Progress.—It is customary for the presidents of these Associations, in their annual addresses, to treat of the developments of the business during the preceding year. This is a matter which can seldom properly be prepared by the President, and as it is the essential duty of the Association to call the attention of its members to all progress which has been made, I think some member of this Association should be appointed to report each year's progress. If a man of this sort can be selected who reads all the published gas literature, including, if possible, the French and German gas journals, much valuable information can be imparted in this way to our members.

Research Work.—If any member of the gas fraternity wishes to do some valuable research work, but does not know what class of work to select, I would suggest the possibility of enriching gas with its own constituents. Acetylene, which has a higher illuminating value than any of the constituent gases which go to make up coal gas, can be produced by passing hydrogen between the carbon points of an arc. This, however, necessitates furnishing the required heat of formation by a very expensive process, and would, therefore, probably not be a commercial success in the enrichment of gas. It might be possible to break up marsh gas and form acetylene gas by passing it between the carbons of an electric arc. In this case no heat of formation would have to be furnished, as the decomposition of the marsh gas would supply more heat than is required for the formation of acetylene gas. I have seen a statement in some of our text books that the hydrocarbons contained in coal gas, including marsh gas, would break up and form the series of hydrocarbons, if subjected to a high temperature. If this is so, we could pass a certain portion of our gas through a scrubber containing cold, heavy, tar oil, and absorb all the illuminants. From here the residual constituants, including the marsh gas, would pass to an externally fired retort and be brought to the temperature where marsh gas would break up and form the illuminating series. Passing out of this retort through recuperative furnaces to heat the incoming gas it would then go to the scrubbers of hot tar oil, which had previously absorbed the illuminants of the gas, when cold, and these illuminants would again be given to the gas.

The results obtained by exposing gas to high temperature would lead to the belief that hydrocarbons always break down in the series going to the hydrocarbon containing the least amount of carbon, rather than to the hydrocarbon containing the greatest amount of carbon. This, however, is in contradiction of the fact that naphthaline appears in water gas when the temperature of the carburetor and superheater is too high. Apparently in this latter case the richest hydrocarbon is formed rather than the lesser series. By heating gas in a furnace of incandescent carbon, or by some similar method, we might be able to build the hydrocarbons up in carbon rather than to break them down.

Another valuable piece of research work which might be accomplished by some one having the time and inclination would be the subject of the flow of gas through pipes. The controversy regarding the flow of gas at different pressures, between the advocates of high and low pressure, seems to me to be almost inexcusable. If our present laws are inaccurate, some of us should develop enough energy to determine accurate laws. Unless the old laws which we have accepted for 50 years are inaccurate, there is no great advantage in the distribution and transmission of gas at very high pressure.

The opportunity for research work in fuel and lighting appliances is almost unlimited. While a given amount of gas burnt will yield exactly the same quantity of heat no matter how it is burnt, yet flame temperature so greatly influences the efficiency of many of our appliances that this field alone offers many opportunities for improvement.

The preheating of gas and air by the waste products of combustion, with a view to obtaining a greater flame temperature for both lighting and fuel purposes, has never been explored to any considerable extent.

The possibilities of increasing the efficiency of incandescent lighting by a system of recuperation are almost unknown. This, besides being economical, might also permit us to use mantles which are less fragile and to all intents and purposes practically indestructible. Valuable results could also be obtained by the mechanical mixing of gas and air, very intimately, prior to combustion.

The field of chemistry in gas manufacture offers an unending opportunity for advantageous research work. The effect of electrical energy waves on gas during its manufacture, such as Roetgen rays, and other rays of extreme chemical activity, is another field of promising possibilities. We might also find that by carefully preparing solutions of oxide to use for mantles for incandescent lighting it would be possible to develop nearly all of our light energy in the form of those selected rays which are the most effective to the human eye, at the sacrifice of the useless rays at each end of the spectrum. I am also convinced that the physical texture of the mantle has some influence on the quality of the rays which it emits.

Future Programme Methods.—If the present programme method fails to prove satisfactory at this meeting, I suggest going back to the former plan of having papers, but that an amendment be made of having at least two reference papers at each of our conventions. By reference papers I mean some paper which will always remain a standard in gas literature, such as a resume of the development of each piece of apparatus used about a gas works. For instance, I would very much like to have in my library a paper tracing the development of the present gas bench, properly illustrated, and also giving all the important forms of benches that at one time or another have been used. A paper on hydraulic mains would be equally interesting and valuable, as would also a paper on scrubbers. I am sure that any one volunteering the compiling of such papers as these would meet with a very warm reception from the programme committee of any of our Associations.

I announce with much regret the death of three members of this Association: Mr. Wm. Stacey, President of the Stacey Mfg. Company, Cincinnati, O.; Mr. H. C. Kirby, President of the Goff-Kirby Coal Company; and Mr. Edward Wehle, of Louisville, Ky.

In conclusion, I wish to express my appreciation of the earnest and intelligent work of our Secretary, Mr. T. C. Jones. He has worked hard and conscientiously for the success of this meeting, and if this convention proves satisfactory to you all, I hope you will record your appreciation by a hearty vote of thanks to our Secretary.

SPECIAL ENGLISH CORRESPONDENCE.

COMMUNICATED BY NORTON H. HUMPHRYS.

SALISBURY, ENGLAND, March 10th, 1902.

Better Late Than Never.—Hudson's Automatic Draught Regulator.—The Disposal of Coke.—Hoc Pretium.

The current issue of the *Journal of Gas Lighting* is a striking illustration of the trend of thought in gas circles, towards the commercial end of the gas undertaking. The editorial notes comprise three separate paragraphs dealing with the maintenance of Welsbach lights on the premises of consumers, and one on the gas stove in the cottage. One of the communicated articles is entitled "An Experience in Canvassing." The author is the engineer of a gas works near London and gives the results of a canvass of his district, undertaken with a view of increasing the use of gas works. It was conducted during the summer of 1901, and the results were so satisfactory that it is to be repeated in 1902. But shortly, they may be indicated by stating the number of consumers and stoves in use in December, 1900 (before the canvass) and in December, 1901 (after the canvass). At the former period there were 2,623 consumers and 546 stoves; at the latter 3,223 consumers and 1,099 stoves. This district appears to have been specially favorable for the labors of the canvassers, the stoves in use only amounting to about one in five consumers. The usual practice is about one to three. It may be said that the effect of one canvass is to bring a backward district well up to the average, and there is good reason to believe that a repetition of the dose will put it into a foremost place. Then the technical record includes a paper on high pressure lighting. The correspondence columns contain a letter on canvassing, in which the writer states that during the year 1901 some 500 or 600 new consumers were obtained by this means, and that the work is still in progress. There are also two letters giving practical experiences on the maintenance question.

By a stretch of imagination let us suppose that the ranks of gas managers included a Rip Van Winkle who settled down for his long sleep in 1870, and awoke in 1902, and it is easy to fancy the amazement with which the practices of to-day would be received. It was somewhere near the earlier period, that the writer, coming into the gas industry as a beginner, ventured to direct attention to the commercial side of the gas business, and suggested that it was worth while to bestow as much pains upon the sale of gas as was usual in regard to commodities in general, and hinted at the possible employment of canvassers. At that time the usual practice was to charge the consumer with the principal portion of the cost of the service, in addition to the fixing of the meter, and frequently a fee was charged for tapping the main in addition. One or two individuals had the hardihood to lay on services free, and were then laughed at as weak brained, but must now be acknowledged as knowing well what they were about. And if the idea of spending £5 to get a consumer had been suggested, it would have been dismissed as utterly ridiculous. Well, better late than never. But in the above named example, where 500 stoves were placed in 1901, it is interesting to speculate as to how many of these new customers might have been put on the books at an earlier period, say 10 years ago. Or to push the inquiry in another direction; how many prospective consumers are there in the United Kingdom to-day, people who are like the young ladies and only waiting to be asked. In almost every other branch of trade the services of the man who knows how to sell to the best advantage are in great demand, but the gas industry has either been stupefied by the soporific influence of the maximum dividend, or dazzled by the will-o'-the-wisp of cheap gas, with the result that the drummer has not been wanted. But the above mentioned facts are signs of an awakening to a better and more healthy state of things, and we may rest assured that in the near future the canvassing department will be a permanent branch of the staff worked with as much precision and system as the charging of retorts or reading the meter indexes.

There are two methods of applying the system of maintenance which have been distinguished by the terms "inclusive" and "partial." According to the first named the company, in consideration of a fixed quarterly payment, find all labor and materials such as mantles, forks and plain glass cylinders, while the second includes labor only, the mantle and glasses being charged as an extra at the current retail price. Both systems are claimed to be in successful operation, and as my own personal experience has extended to the inclusive system only, I cannot say anything about partial maintenance; nor do I attach much importance to the details by which it may be carried out so long as the gas company get an opportunity to accept the control and responsibility for the burners, and the right to see that they are in good order. It is needless to state that any scheme of maintenance must depend upon the co-operation and good feeling of the consumer. This is very easily attained, seeing that all he wants is a good light and avoidance of troubie, and when once a few shops are taken in hand the thing advertises itself, the burners under the care of the gas company's experienced inspectors presenting a marked improvement on the average run.

All who are interested in the modern developments of retort house firing will do well to read a paper submitted a few days since at a meeting of the Manchester District Institution of Gas Engineers, by Mr. Hudson, dealing with the control of chimney draught, and including an illustrated description of a bell governor, throttle valve regulator applied at the base of the chimney in a manner similar to that adopted in connection with the pressure at the inlet of the exhauster. The usual experience is not only that the draught of the chimney may be affected by wind, but that it is influenced by the condition of the furnace in respect to clinkering, and there is no doubt but that the use of a controlling apparatus as described is an excellent adjunct. A very general practice is to divide up the chimneys rather than to trust to one or two large ones, but some works are so situated that a lofty chimney is a necessity. It is easy to arrange a chimney not more than 20 feet long, and just showing through the roof on the top of each setting, and thus render the effect of variations in the draught a separate affair in each case. But when the products of combustion must be diffused at an altitude of 150 to 200 feet, the main chimney is unavoidable. Some endeavor is made to adjust the draught according to the number of settings in use by means of dampers at the base of the chimney, but even then a defect in one furnace may interfere with the pull on the whole. Mr. Hudson's arrangement is both ingenious and novel, and it bears a similar relation to other means of regulation, as that of a float governor compared with an ordinary check valve.

Another subject discussed at the same meeting was the disposal of coke. I think a gentleman has directed attention at one of the American Gas Managers' meetings, to the intrinsic value of coke as a fuel as compared with coal, and argued that such value should be an indication of the market price attainable. What with increased make and improved furnaces, there has been a very large increase in the production of coke. And in many cases the surplus is got rid of by selling it to a dealer or agent at a take-it-away price, and with a proviso that it is not to be offered for sale in the town or district where it is made. The coke trade in the district where I am writing is greatly weakened by a similar practice, and merchants at the railway yards here are able to get coke from a distance of 60 miles at a price 6s. or so below my current yard rate. This is supplied through an agent, so after the railway charges and the agent's profits are paid the amount netted by the makers must be but a very small proportion of the intrinsic value as a fuel. The remedy for this state of things, as pointed out by Mr. W. Whatmough, the author of the paper, is to be found in the cultivation of a retail trade, strict attention to the demand as to different sizes, etc., and the prompt delivery of small quantities, if only one bag, at the premises of the purchaser. He contends, and very wisely, that the people who use the gas will also take the coke. I know they will do so when encouraged as above indicated in districts up to 20,000 inhabitants. In larger towns the consumption of gas is not greater *per capita*, and there is no reason why a district of 200,000, or 2,000,000 for that matter, should not also consume its own coke. Much of the coke which is rushed headlong on the market, is eventually placed by dealers and merchants at prices somewhat approaching its proper value. In an earlier part of this letter I have alluded to the increase of business secured by canvassing for gas consumers. Why should the canvass be confined to gas? Many people have never tried coke. There are many positions where smoke or soot is an objection. All these things should be looked up and made known in an attractive form. The author's experience agreed with that expressed in the discussion, and the whole goes to show that the disposal of coke at prices somewhat approaching its value as a fuel when compared with coal, is not a cumbersome or a complicated task, and that the cost of breaking, sorting, and bagging-up can be reduced by the aid of machinery to a very small sum per ton. One very general difficulty is that the average house may have a coal hole to accommodate a stock of coal, but there is no place to lay down even 5 cwt. of coke. Obviously under such circumstances it is no use to expect to do business under the usual rate of not selling less than half a ton at a time. The coke trade is often throttled and smothered by autocratic arrangements of this kind. But because the coke will not sell in half ton blocks, it does not follow that a few intelligent dealers, with no other capital than a donkey and cart, could not earn a respectable, decent living by taking coke at the gas works in half ton lots bagged up in half cwts. or cwt., and retailing the same in the working class districts of the town. A regular daily demand is the thing to be secured. It is better to load coke into a cart and see it off out of the works than to trim it in a heap and in the course of a few days or weeks to dispose of the whole heap. The cost of trimming and waste is an important item. And while it is quite right to look out for the top price a very considerable portion of the lack of skill and bad trade is due to taking too firm a stand and obstinately adhering to a figure higher than that which the consumers are willing to pay. Desperate cases call for desperate remedies, and when the yard is blocked full of coke the dealer knows that his opportunity has arrived and requires the inducement of a ridiculously low price. Then he in his turn having guaranteed to remove a certain large quantity within a given time may find himself in a similar fix, and be compelled to pass the coke on to a second dealer or to some consumer who happens to get into the swim, at a price but little more than he gave for it. All this can be avoided by a reasonably moderate reduction in the first place. In the case of a residual like coke which is turned out as a by-product in quantities altogether independent of the demand for it, there is no possibility of forcing the market, and neglect or inability to appreciate this point is the cause of much trouble. There is always a supply of coal and other solid fuels available so that the public can do without coke if they choose to do so without a lot of inconvenience, and in most towns there are coal merchants and others who would rather that the public came to them for coal than went to the gas works to buy coke.

In connection with the discussion in this paper an interesting point arose. Mr. Meunier, of Stockport, to whom I have previously referred as having done something more than talk about the question of coke disposal, suggested that a committee should be appointed to deal with questions of prices, not of coke alone but of any material or residual pertaining to gas works, so that each member could obtain full and complete information for guidance in advising his committees. And this brought out the rejoinder that the Association was a technical and not a commercial society. This is a distinction without a difference. What is the use of studying improved technical processes if the whole thing is not carried to the full length? Much of the present trouble is

due to increased production following improvements in furnaces, the introduction of which has been greatly assisted and facilitated by the works of the Associations. Surely, having shown a member how to make another 1,000 tons of coke a year for sale it is not stretching the thing too far to tell him how to sell it or to assist him to that end. Big makes per ton and big yields of coke are only of value in so far as they are evident in the annual balance sheet. And it is a notable fact that the men who show the best working results are not necessarily those who pay the biggest dividends. To hark back to the beginning of this letter, Mr. Meunier's proposition is only an example of the trend of thought towards the commercial end of the concern. Gas engineers have been carefully scraping up the coppers in the technical department, by squeezing out another 100 or 200 cubic feet per ton of coal or by reducing the cost of purification to the extent of a tenth of a penny per 1,000 cubic feet. But they are now waking up to the fact that while they are saving the pennies, combinations in regard to the price of coal, iron, fireclay and other materials may touch them to the tune of several pounds. They are realizing the importance of selling in the dearest and buying in the cheapest market, which really means selling direct to the user and buying direct from the maker or producer. Mr. Meunier has touched an important point, and we have not heard the last of his proposal.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

Mr. W. C. Thomas has resigned the dual position of Treasurer and General Manager of The Gas and Electric Company, of Bergen County, N. J., the resignation to take effect to-morrow. He retires from active duty with the best of good wishes from everyone connected with the concern.

The proprietors of the Logan Iron Works, Brooklyn, N. Y., are under contract to furnish two holders for the gas plant, that is to be erected by the proprietors of the Citizens Light and Power Company, at Auburn, N. Y. The storage holder is to be of the double-lift order, and its capacity is to be 200,000 cubic feet. The relief holder is rated to a capacity of 25,000 cubic feet, and both holders are to rest in steel tanks. The Messrs. Logan have agreed to complete the contract before August 1, 1902.

The following letter, from Col. F. S. Richardson, Treasurer and Manager of the North Adams (Mass.) Gas Light Company, written from North Adams, under date of the 25th inst., explains itself:

To the Editors American Gas Light Journal: Recent newspaper reports of a gas explosion in North Adams refer to one that did occur in the house, and upon the property, belonging to the Arnold Print Works, adjoining our works, but sufficiently removed from us to escape all harm or danger. How the leak occurred no one knows, but two men found it in the small holder house, which they entered carrying a lighted lantern! No lives were lost, but the damage to property was considerable, and much window glass was destroyed. The force of the explosion was tremendous for such a small quantity of gas, less than 9,500 cubic feet being stored in the two tanks. Their supply was uninterrupted, the explosion having occurred on Sunday night, and the necessary 6-inch connection was made within 3 hours. Of course, our 2 large meters in commission were ruined.

Superintendent Steinwedell, of the Belleville (Ills.) Gas Light and Coke Company, will have a busy time of it this season in directing the construction of a water gas annex to the plant, the contract for the furnishing of which has been awarded to the Western Gas Construction Company, of Fort Wayne, Ind. The betterment plan includes the placing of a relief holder.

A correspondent forwards the following under date of March 26th, from Pittsfield, Mass.: The new offices and store of the Pittsfield Coal Gas Company at 30 South street, occupying the entire building, have practically been completed, and will be opened in a very few days. In fact, considerable business has already been done in the new place, and it has been visited by a large number of people. The main floor is occupied as a store and office, and here may be seen anything in the line of gas appliances from a lamp chimney to a gas engine. The Company makes a specialty of gas ranges. Heating appliances of all descriptions and cooking apparatus of all kinds are shown, and the display is highly interesting, giving, as it does, an idea of the large number of uses to which gas may be advantageously put. The office occupies a spacious portion of this floor and is neatly and conveniently arranged. The business of the Company will be transacted here, including the payment of bills, sale of coke and by-products of the plant at Morningside, etc. The room is handsome in appearance, the effect, all in light colors, being most pleasing. The store has undergone a complete transformation, comprising new floor, new paint and paper and new decorations throughout. The basement is occupied as a work room and for the storing of material, and a vast amount of stock and fixtures is carried. The second floor will be used for the giving of cooking demonstrations, and for such other uses as may be found desirable. All in all, the new place is a delight to the eye, and Manager Woodward is justly proud of the light, airy and roomy quarters which will soon be formally occupied by the Company. The store will this week be open for business, and it will doubtless be visited by a large number of gas takers in this city. It is highly probable that the enterprise of the Company in opening this store and carrying all conceivable gas appliances will largely increase the uses to which gas is put locally, as well as introducing a much more extensive use of this product, especially for lighting, heating and cooking.

A widely circulated report that the Columbus (O.) Gas Company had determined to suspend the manufacture of illuminating gas, substituting therefor a full supply of natural gas has been emphatically denied by the Company's Manager, Mr. J. O. Johnstone. He declares that such a proposition has not even been considered by the proprietors of the Company.

The annual convention of the Engineers, Superintendents and Managers of the United Gas Improvement Company, was held in Philadelphia, March 20, 21 and 22. Headquarters were in the Continental Hotel, and a large number participated in the proceedings, which, as one who took part in the meeting, unreservedly stated to us last week, were of an especially instructive and interesting order. The feature of the outing programme was a trip to Atlantic City, the delegates going to the City Saturday afternoon, and returning therefrom the following Monday.

At a meeting of the Directors of the Cincinnati Gas and Electric Company Messrs. Charles P. Taft and J. Benson Foraker, Jr., were chosen to the Board to succeed Messrs. John T. Sheldon and C. W. Wetmore. The retiring Directors represented the interest of the North American Company on the Board. It is well understood now that the North American Company is altogether out of the Cincinnati Gas and Electric Company's affairs.

The Sweeten and Purviss Electric Light and Power Company, of Glassboro, N. J., to construct, operate and maintain electric light and gas plants at Sweeten and Middleford, Sussex County, Delaware, has been incorporated with a capital of $100,000.

"A. R. M.," writing from Washington, D. C., under date of the 24th inst., says there is little likelihood that the authorities of Alexandria, Va., will accept the proposition submitted by Mr. Frank Goldsborough and his friends to lease and operate the city gas works. In fact, he adds, "It is quite certain the authorities will order the expenditure of a considerable sum of money to put the works in thorough repair."

The Western Gas Construction Company will construct the generating apparatus for the new plant that is to be operated at Petoskey, Mich., by the proprietors of the Petoskey, Bay View and Northern Gas Company.

The authorities of Paris, Kentucky, have authorized the Paris Gas Company to maintain on the streets for public lighting account 123 lamps of the Welsbach type, at the rate of $26.50 per lamp per annum. The lights are to burn all night and every night. The balance of the public lighting will be performed by the Paris Electric Light Company, which will maintain 35 arc lamps, on an all night and every night schedule, the payment to be $110 per lamp per annum.

The capital stock of the Sterling (Ills.) Gas Company has been increased to $250,000, and the Directors will hereafter number 5 instead of 7.

Certain residents of Ludington, Mich., have applied to the authorities for the right to construct and operate a gas works at the point named. The application binds the projectors not to make a selling rate in excess of $1.50 per 1,000 cubic feet.

The City Council of Chicago Heights, Ills., has agreed to permit the projectors of the Chicago Heights Gas Company to construct and operate a works. The authorities allow the concern 5 years within which to have the works in operation, and, although that period should be sufficiently lengthy for the completion of the plant, it is our belief that the works will not even then be a "going concern."

THE New Haven (Conn.) Gas Light Company has adopted the system of bonding all of the employees connected with its business department. The expense of the bonding is borne by the Company.

SOME days ago the proprietors of the Paterson and Passaic (N. J.) Gas and Electric Company acquired the plot of ground on Ellison street, near Paterson, formerly occupied by Dr. W. Herbert Lowe. The building on this site, which measures 50 by 125 feet, was destroyed in the great fire last month. It is the intention of the Company to erect a two-story brick building, to be occupied as the general offices and also warerooms for the sale of gas and electric fixtures, etc. The new structure will occupy a plot covering the entire width of 50 feet and will run back a distance of 100 feet. No plans have been drawn as yet; in fact, the Company has not advertised for designs, and nothing but a general idea has been formed in regard to the building. Adjoining the plot, to the west, is a 15-foot alley, which runs to the old power house of the Electric Company at the rear. The new location will be satisfactory to the Company's patrons. All bills will be payable there, and the business of the Company will also be transacted there. Almost the entire front of the ground floor will be of plate glass, thus affording plenty of light and also good show windows.

THE proprietors of the Oshkosh (Wis.) Gas Light Company have arranged for the placing of several miles of mains to the Company's distributing system.

THE officers of the new Company for Boise City, Idaho, which concern is known as the Boise Gas Company, Ltd., are as follows: Directors, C. E. Burrows, Walla Walla, Wash.; M. V. Tweley, Waitsburg, Wash.; and George W. Baker, B. F. Olden and H. P. Ustick; President, B. F. Olden; Vice-President, Geo. W. Baker; Secretary, William Simons; Treasurer, H. P. Ustick. The capital is $100,000, and it is quite certain that a works will be built in Boise this summer.

The Market for Gas Securities.

The adjournment of the Legislature without the passage therethrough of any adverse laws regarding the local gas companies, together with renewed rumors respecting the thought for union of the Consolidated and Brooklyn Union Companies, may be held responsible for an advance this week in the securities of the named concerns. Consolidated closed yesterday (Thursday) at 225 bid, offered at 225½, and Brooklyn Union was reported at 224½ to 225. There would seem a fair prospect of higher figures being shortly made in both classes of shares.

There is no particular change in the general situation, although there can be no chance to deny the statement that every indication points for higher prices. Peoples, of Chicago, sold up to 102, and Baltimore Consolidated keeps on the advance that was started in it some 3 months ago. Bay State gas has been traded in to considerable volume, 1 being the prevailing figure. Holders of Washington gas are wondering how much higher the quotations therefor can go.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

MARCH 31.

☞ All communications will receive particular attention.
☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	225¼	225½
Central Union, Bonds, 5's.	3,000,000	1,000	110	111½
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	..	108	112
Mutual	3,500,000	100	310	325
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	111½	..
Northern Union Bonds, 5's.	1,250,000	1,000	106	108
New York and East River ..				
Bonds 1st 5's	3,500,000	1,000	112	113
" 1st Con. 5's	1,500,000	..	109	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	
Standard	5,000,000	100	130	140
Preferred	5,000,000	100	150	160
Bonds, 1st Mortgage, 5's	1,500,000	1,000	118	..
Yonkers	299,650	500	180	
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	224	225
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	1	1¼
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works,..	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust....	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	10½	11⅜
" " Bonds, 5's	5,250,000	1,000	79	80¾
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	102⅛	102¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	218	225
Consolidated, Baltimore...	11,000,000	100	68¼	69
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's....	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	13	14
" Con. Mtg. 5's	880,000	1,000	80	81
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50		89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	70	73
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	34	38
Fort Wayne	2,000,000	..	.	.
" Bonds	2,000,000	..	53	55
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	70	
" Bonds, 6's	2 650,000	..	103	104½
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	290,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100		90
Preferred	2,500,000	100	106	110
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	57	62
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	109½
" 6 per cent. scrip, due 1910	100,000	25	25	87
Montreal, Canada	2,000,000	100	182	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
New Haven	1,000,000	25	300	325
Nashville Gas Lt. Co.	1,000,000	100	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	102⅛	102¼
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage....	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co..	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	48	48½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's.	650,000	1,000	113	116
Extension, 6's,	600,000	1,000	113½	115
General Mortgage, 5's..	2,465,000	1,000	93	96
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	98	96
Syracuse, N. Y.	1,750,000	100	15	17
Bonds	1,612,000	1,000	95½	97½
Washington, D. C	2,600,000	20	405	407
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	..	106½	108
Wilmington, Del	600,000	50	232	

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OFFICE OF THE UNITED GAS IMPROVEMENT CO., N. W. CORNER BROAD AND ARCH STS., PHILADELPHIA, PA., March 12, 1902.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 15th, 1902, to stockholders of record at the close of business, March 31, 1902. Checks will be mailed.

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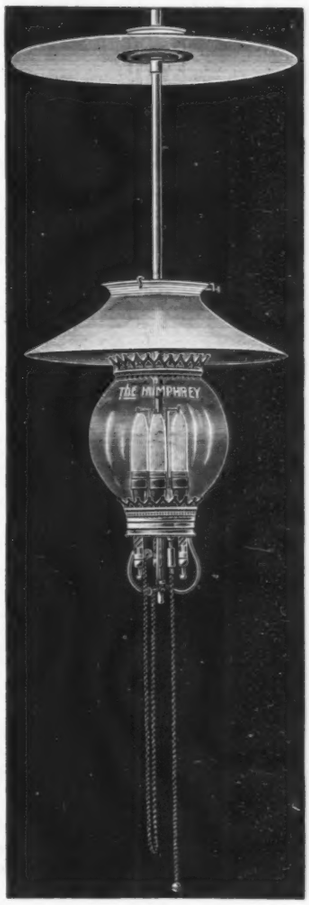

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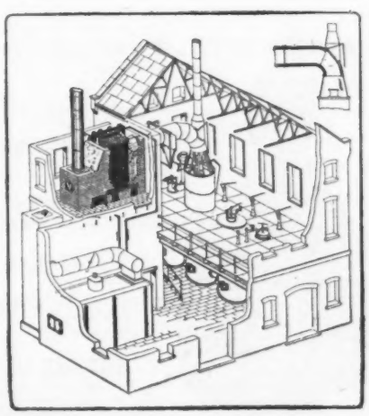

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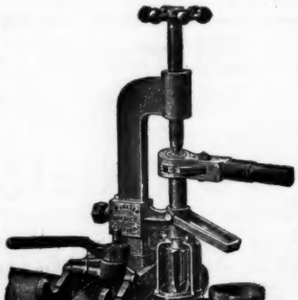
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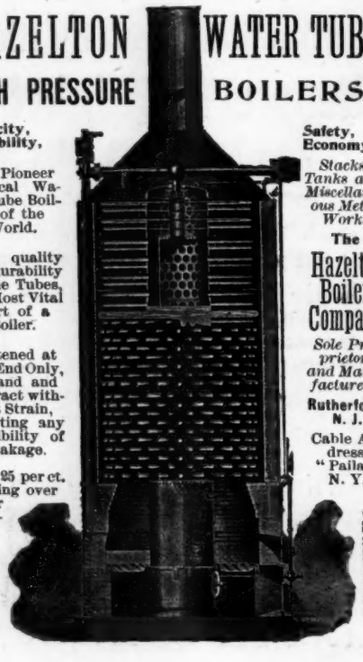

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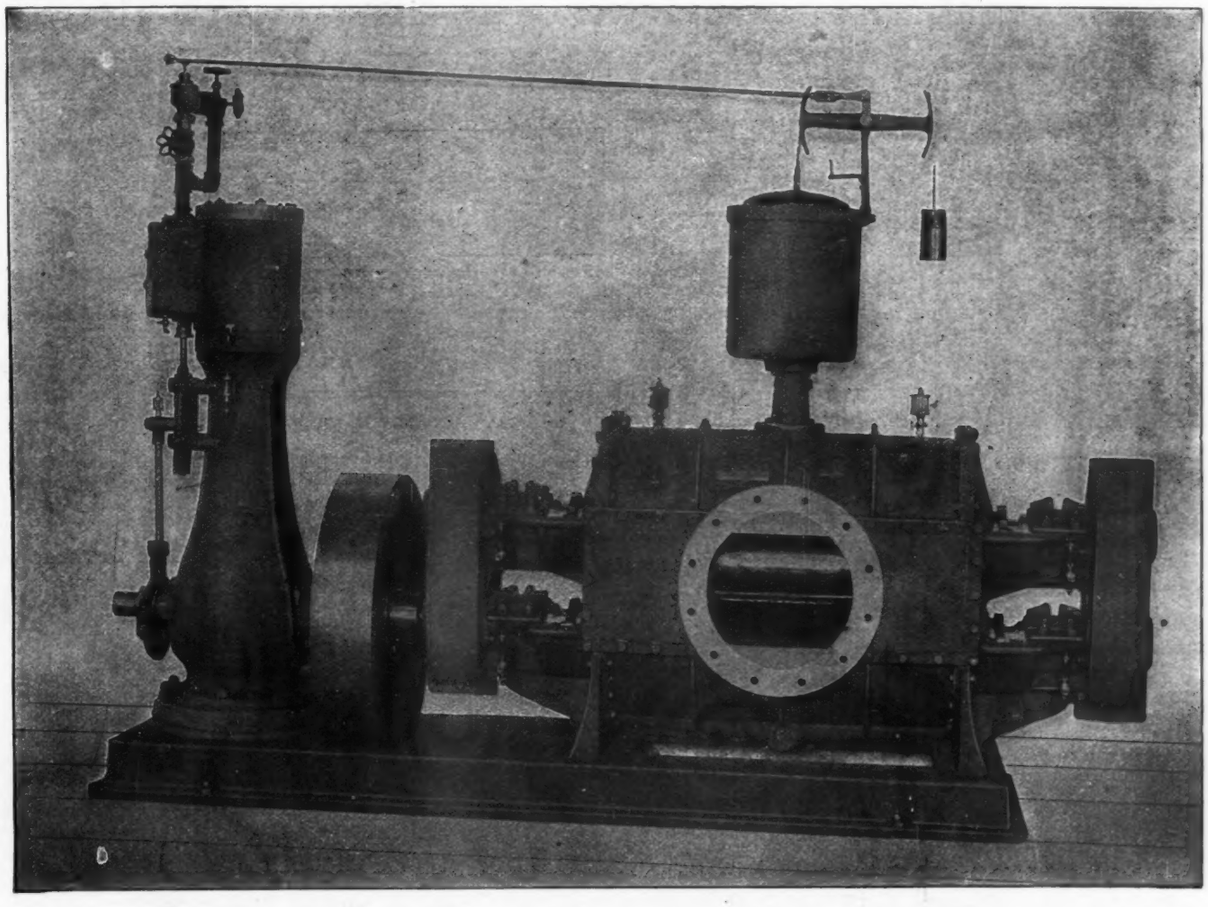

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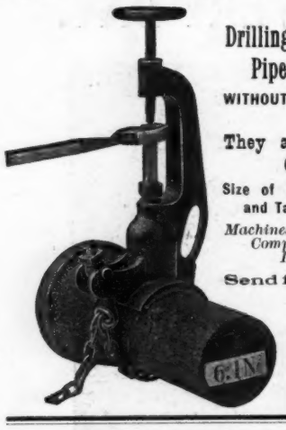

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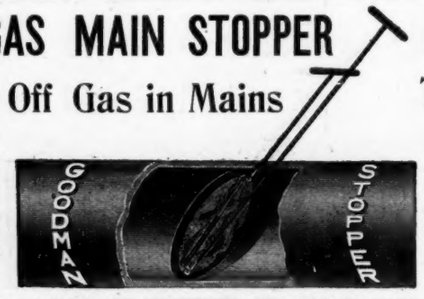

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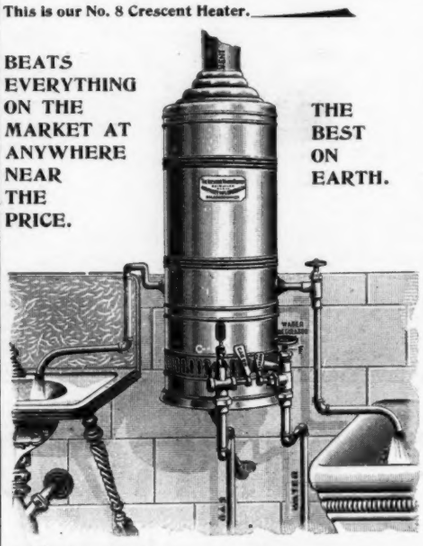

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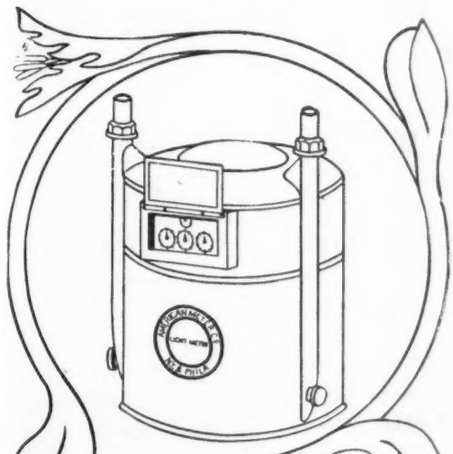

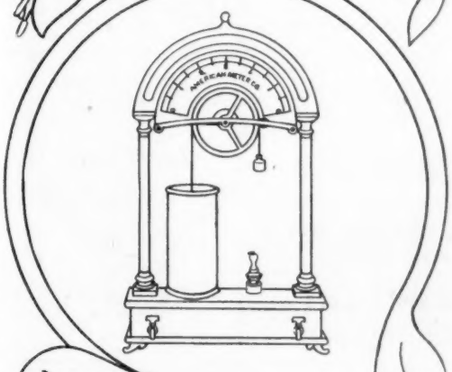

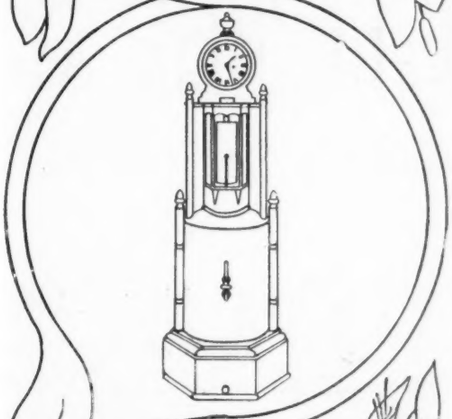

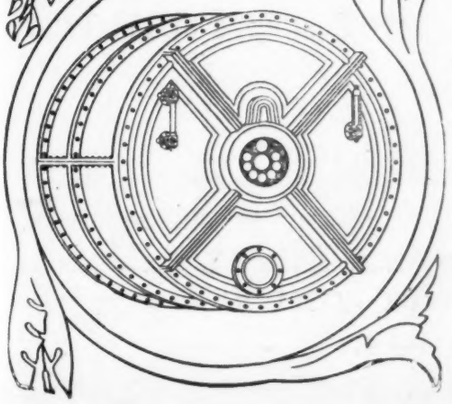

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CHICAGO, ST. LOUIS,

SAN FRANCISCO.

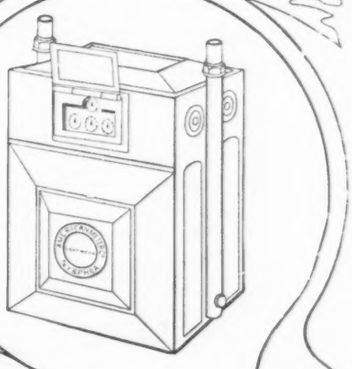
PUBLIC LIGHTING TABLE.

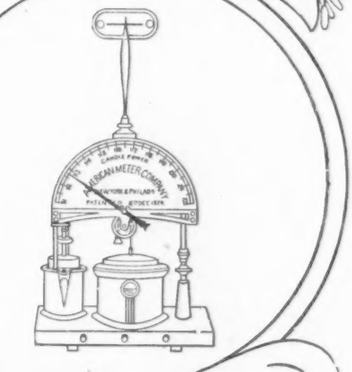
APRIL, 1902.

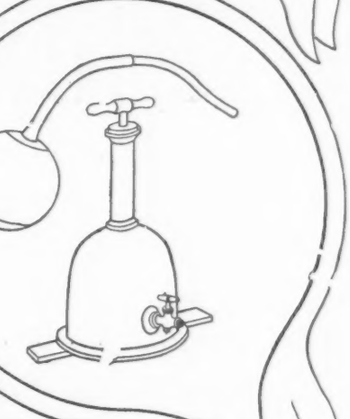
Day of Week.	Table No. 1. Following the Moon. Date.	Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Tue.	1	6.50 PM	2.50 AM	6.10	4.55
Wed.	2	6.50	3.30	6.15	4.40
Thu.	3	6.50	4.10	6.15	4.40
Fri.	4	6.50	4.40	6.15	4.40
Sat.	5	6.50	4.40	6.15	4.40
Sun.	6	7.00	4.30	6.15	4.40
Mon.	7	7.00	4.30	6.15	4.40
Tue.	8	7.00 NM	4.30	6.15	4.40
Wed.	9	7.00	4.20	6.25	4.30
Thu.	10	7.00	4.30	6.25	4.30
Fri.	11	7.00	4.30	6.25	4.30
Sat.	12	7.00	4.30	6.25	4.30
Sun.	13	11.20	4.20	6.25	4.30
Mon.	14	12.10 AM FQ	4.20	6.25	4.30
Tue.	15	12.50	4.20	6.25	4.30
Wed.	16	1.30	4.20	6.30	4.20
Thu.	17	2.00	4.20	6.30	4.20
Fri.	18	2.30	4.20	6.30	4.20
Sat.	19	3.00	4.20	6.30	4.20
Sun.	20	3.30	4.20	6.30	4.20
Mon.	21	No L.	No L.	6.30	4.20
Tue.	22	No L. FM	No L.	6.30	4.20
Wed.	23	No L.	No L.	6.40	4.10
Thu.	24	7.20 PM	9.40 PM	6.40	4.10
Fri.	25	7.20	10.30	6.40	4.10
Sat.	26	7.20	11.20	6.40	4.10
Sun.	27	7.20	12.10 AM	6.40	4.10
Mon.	28	7.20	12.50	6.40	4.10
Tue.	29	7.20	1.30	6.40	4.10
Wed.	30	7.20 LQ	2.00	6.45	4.00

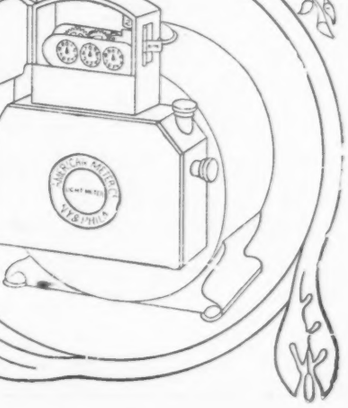
TOTAL HOURS LIGHTING DURING 1902.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	238.30	January	423.20
February	196.20	February	355.25
March	196.20	March	355.35
April	166.40	April	298.50
May	151.40	May	264.50
June	131.10	June	234.25
July	142.40	July	243.45
August	162.00	August	280.25
September	179.00	September	321.15
October	216.30	October	374.30
November	224.10	November	401.40
December	250.00	December	433.45
Total, yr.	2255.00	Total, yr.	3987.45





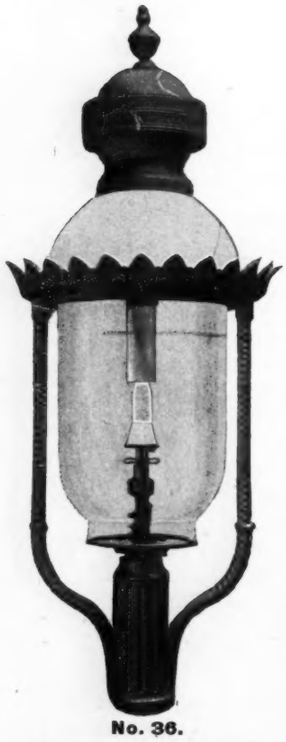




NEW YORK, 33 Nassau Street. PHILADELPHIA, Broad and Arch Streets. CHICAGO, Foot of Orleans Street. BOSTON, 624 Tremont Building.
CLEVELAND, 809 Cuyahoga Building. ST. LOUIS, 712 Roe Building. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



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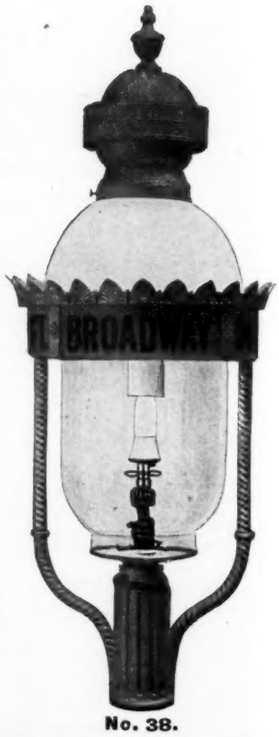

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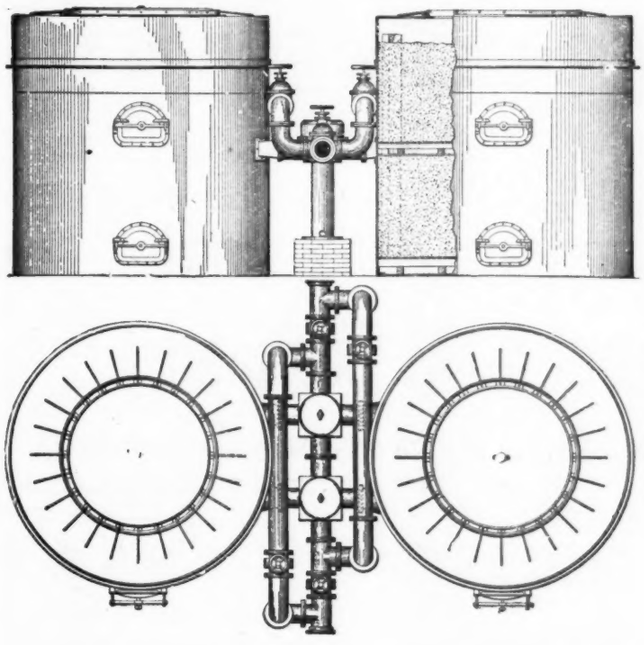

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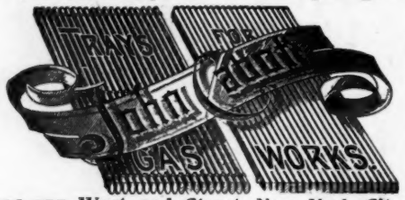

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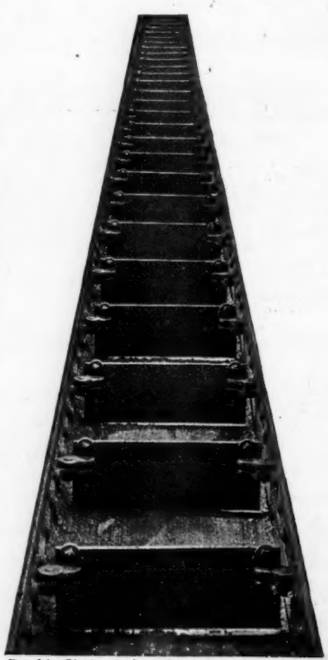
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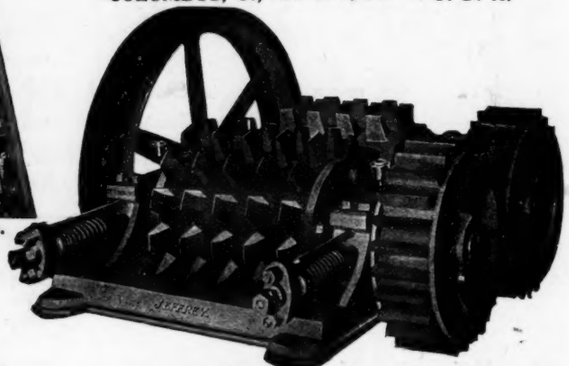

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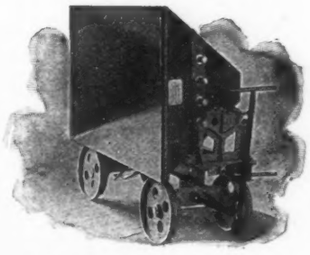

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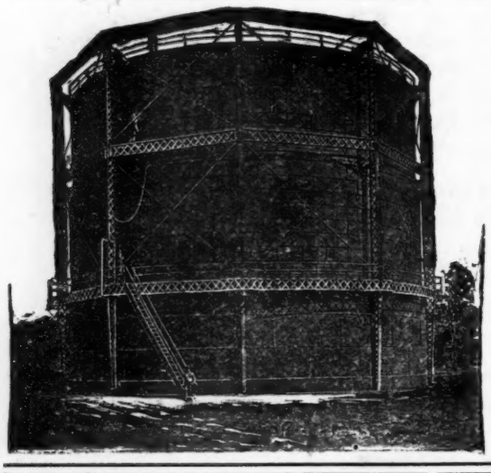

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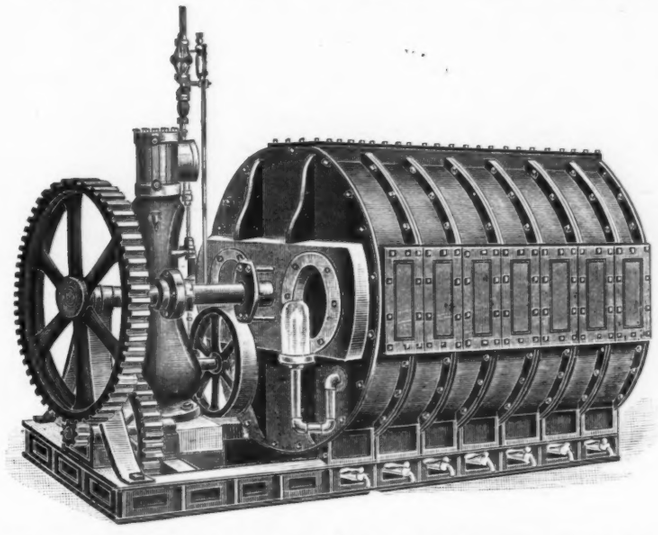

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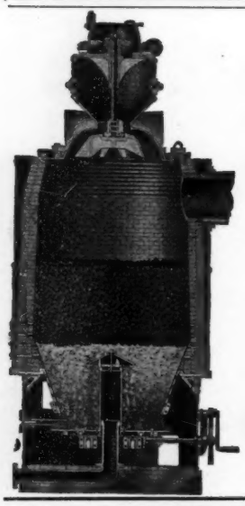

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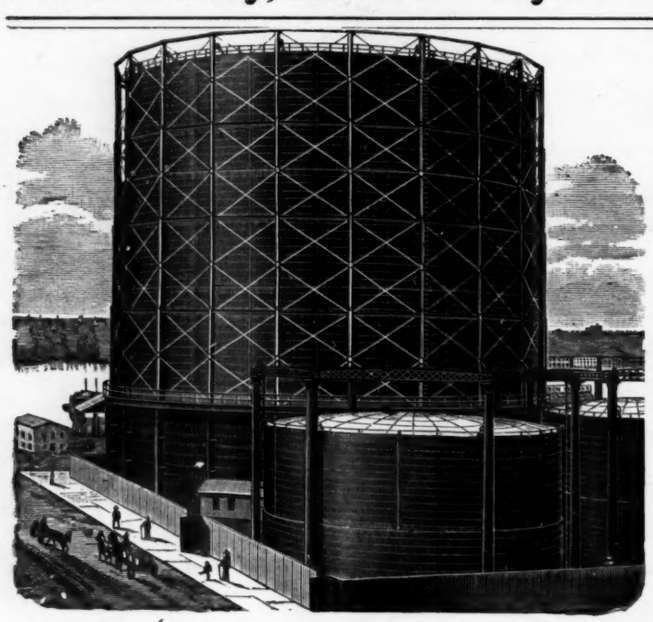

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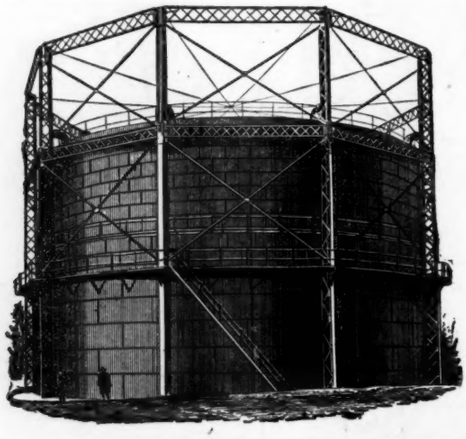

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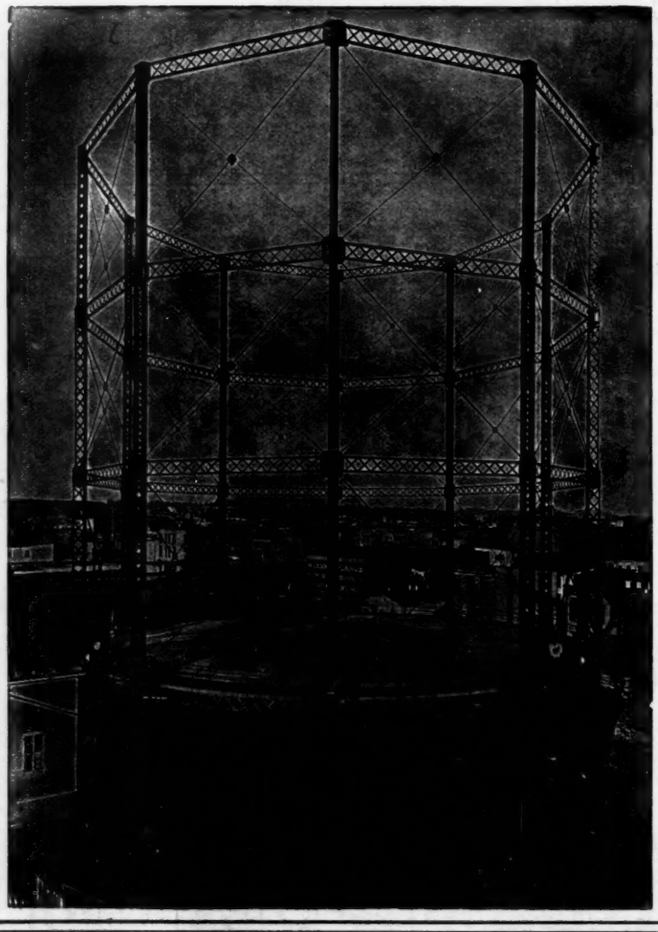

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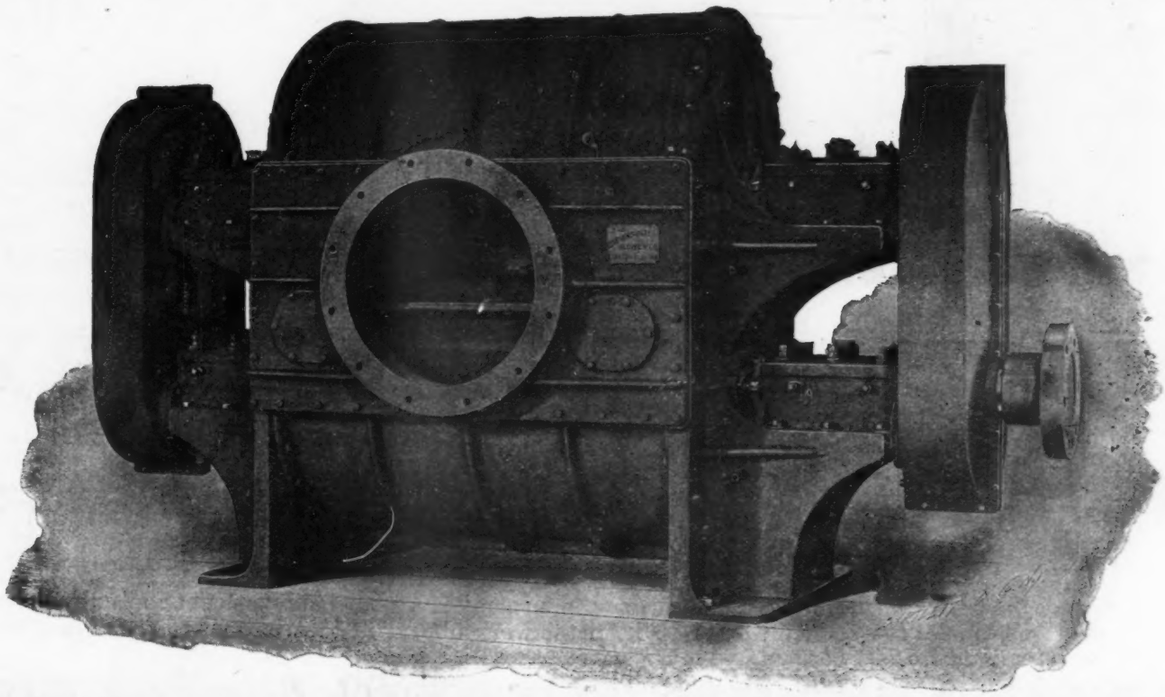

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